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INFORMATION REPORT INFORMATION REPORT

CENTRAL INTELLIGENCE AGENCY

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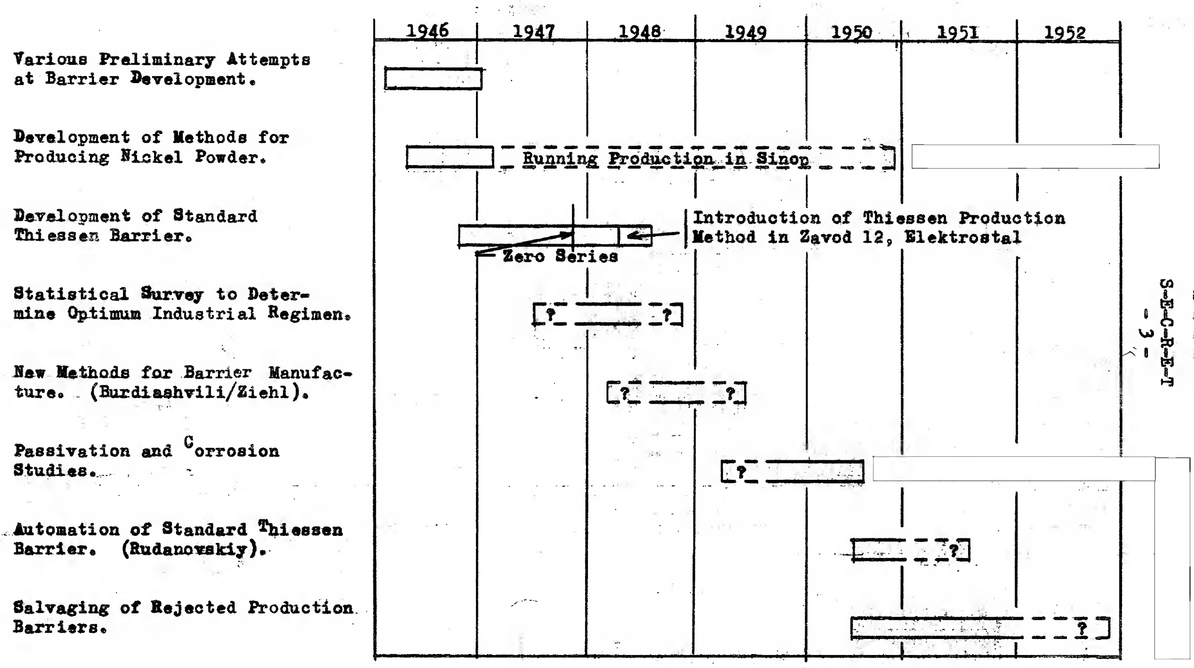
TIME TABLE FOR GASEOUS DIFFUSION BARRIER

DEVELOPMENT IN SINOP



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INTRODUCTION

1. 25X1

2. Until 1952, the highest authority of the combined Sinop and Agudzeri institutes was Gen. Aleksandr Ivanovich Kochlavashvili, who was succeeded for a short time in 1952 by Col. Lordkipanidze (fnu); sometime in 1952, this office was abolished. 25X1 Kochlavashvili's official title was Plenipotentiary of the Council of Ministers. He appeared to act as liaison between Sinop and the highest supervising echelon in Moscow, as well as between Agudzeri and Moscow. When the Sinop and Agudzeri institutes were combined in 1950, the first director of the combined institutes was Vladimir Vasilyevich Migulin, a physics professor from Moscow University. Most of the administrative sections in Agudzeri were moved to Sinop, and only branch administrative offices were maintained in Agudzeri; administration was under the Soviet deputy for administration, Petr Varlamovich Chelidze. The scientific technical offices in Agudzeri and Sinop were under two deputies for technical matters, Boris Mikhaylovich Isayev (First Deputy Director) in Sinop and Ilin Filippovich Kvartskhava (Second Deputy Director) in Agudzeri. The divisions of responsibility between the two deputy technical directors was not made on the basis of geographical location alone. Kvartskhava was responsible for some departments in Agudzeri but also for at least one department in Sinop, viz., the Thiessen department. Likewise, the department of Werner Schuetze[1] in Agudzeri was not responsible to Kvartskhava but to Isayev who had his office in Sinop. Evidently the division between the two deputies was on the basis of scientific fields, with Kvartskhava supervising departments with an emphasis on chemical science, whereas Isayev supervised departments with a primary emphasis on physics.

ORGANIZATION OF THE THIESSEN DEPARTMENT FROM 1946 TO 1952

3. The work of setting up Sinop Institute and the Thiessen department began in fall 1945 and continued through spring 1946. A few Germans, however, had already begun minor research tasks. 25X1

25X1

25X1

4. On 10 May 1946,[2] conferences took place in Sinop at which each department, i.e., that of Thiessen, Max Steenbeck, and Manfred von Ardenne, was given its assignment for the next years. [redacted] 25X1

5. Three leading Soviet scientists participated in these conferences. They had been in Sinop for some time in 1946, and had assisted the three German department chiefs in setting up the institute. [redacted] 25X1 the name of the scientist who assisted von Ardenne, viz., Bonch-Bruyevich (fnu). [redacted] the scientist who assisted Thiessen was elderly, was balding, and had one or two prominent swellings on his head.

6. As a positive incentive, the Germans were shown a table on which a premium or award was listed for each task. It was during one of these conferences that the Thiessen department was given the project of developing barriers for gaseous diffusion. [redacted] 25X1

7. The Thiessen department worked on the barrier project from 1946 to 1952, although the problem of producing a workable barrier had been essentially solved by 1948. During these years, the Thiessen department was organized as shown on the chart on page 6.

Key to Organization Chart

8. [redacted] 25X1 The function of the various sections during the different periods will be tabulated below. The personnel have been listed by numbers: the numbers 1 to 32 apply to German nationals; the numbers 50 and higher apply to Soviet nationals; an asterisk beside a number indicates the head of the section.

Personnel /numbers refer to the organizational chart on page 6/[3]

1	Prof. Peter Adolf Thiessen	[redacted] 25X1
2	Dr. Gerhardt Siewert	
3	Dr. Werner Wittstadt	
4	Dr. Hans Bartell	
5	Ludwig Albert Wilhelm Ziehl	
6	Wilhelm /Willi/ Lange[4]	
7	Erich Wilhelm Franke	
8	Wolfgang Friedrich Srocke	
9	Werner Siegling	
10	Kurt Heptner	
11	Irmgard Schumacher (née Striepling)	

- - - - - - - - - -

[redacted] 25X1

3. Numbers 69 to 75 and No. 29 appear only on the chart of the organization of the department under Boris Petrovich Mitrenin given on page 11 below.

[redacted]

5. [redacted] 25X1

25X1

SECTIONS	1 Mid-1946	2 End-1946	3 1947/48- 1948/49	4 1949 to Aug.1950	5 Aug.1950- End-1952
(A) Metallurgical Lab I	50*	16*,51,21, 68	51*,21,68,	51*,21,68,	51*,68
(B) Metallurgical Lab II	///	5*,26,15	///	///	63*,67,64
(C) Technological Section	///	///	5*,12,13, 14,19,20, 23,24,25, 52,55,56, 57,60,61, 8,9,15,26	5*,54,55, 25,58,56, 57,10,23, 24,26	54*,55,25, 10,57, 5, 58,59,60
(D) Design Section	6*,11	6,11	22*, ?	22*,26	22*,26
(E) Thiessen's Private Laboratory	1*,13	1*,12,13, 14,	///	1*,13	1*,13
(F) Physical Laboratory	4*,12	4*,18,19 20	4*,18	4*,18	4*,9
(G) X-Ray Laboratory	3*,7,10,	3*,7,10, 64	3*,10,27, 65,66	3*,27,7, 31,32	3*,7,27,
(H) Chemical Laboratory	2*,5,26	2*,52,53, 26,55,31, 32	62*,31,32	62*,61,52	62*,61,52
(I) Workshops	8,9	8,9	? ?	8,9	8

ORGANIZATION CHART OF THIESSEN DEPARTMENT

25X1

12 Susanne Srocke (née Kittan)
13 Ingrid Schilling [6]
14 Martin Krecker [7]
15 Karl Urban Melcher
16 Juergen Artur Ziegler [8]
17 Horst Paul Schnaase [9]
18 Waldemar von Maydell
19 Schulze (fnu)
20 Heinrich Matthias Eulen
21 Eduard Schmitz
22 Walter Hartz
23 Gustav Karl Fliegner
24 Kurt Panten
25 Helmut Hepp [9a]
26 Dorothea Thiessen
27 Margarete Susu Devrient
28 Dr. Ernst Emil Rexer
29 Fritz Engelhardt
30 Heinz Rackwitz
31 Dr. Heinz Karl Moehr
32 Dr. Wolfgang Gramberg

50 Aksyanov (fnu)
51 Burdiashvili, Shaley Savovich
52 Lomadze, /Eteri/
53 unidentified
54 Prokudin, Ivan Petrovich
55 Yelkin (fnu)
56 Gorizontov, /Boris Arkadyevich/
57 Toshchev (fnu)
58 Listopad (fnu - husband)
59 Listopada (fnu - wife)
60 Suslenikova, Vera Mikhaylovna
61 Frolova (fnu)
62 Sokolova (fnu)
63 Rudanovskiy (fnu)
64 Oziashchvili, Edika
65 unidentified
66 unidentified
67 unidentified
68 Shamba, Nadezhda Alekseyevna
69 Assotiani, Yasha Rademovich
70 Skiriya (fnu)
71 Fursa (fnu)
72 unidentified
73 Tsomaya (fnu)
74 Kirvalidze (fnu)
75 Mitrenin, Boris Petrovich

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25X1

25X1

Functions of Sections

9. Each section of the Thiessen department is identified by a letter from A to I. The various periods shown on the organizational chart are identified by digits from 1 to 5. For example, the code A - 3 refers to Metallurgical Laboratory I during the period 1947/1948 to 1948/1949:

For convenience, the sections and time periods are listed again:

A - Metallurgical Laboratory I

B - Metallurgical Laboratory II

C - Technological Section

D - Design Section

E - Thiessen's Laboratory

F - Physical Laboratory

G - X-Ray Laboratory

H - Chemical Laboratory

I - Workshops

1 - mid-1946

2 - end-1946

3 - 1947/1948 - 1948/1949

4 - 1949 - August 1950

5 - August 1950-1952

Section A-1 :	Preliminary experiments for the manufacture of metal diaphragms.
Section A-2 :	Manufacture of highly dispersed reduction powder and powder mixtures.
Section A-3 :	Manufacture of diaphragms by means of sedimentation.
Section A-4 : Section A-5 :	Continued development of diaphragms.

Section B-1:	Non-existent.
Section B-2:	Manufacture of nickel carbonyl powder.
Section B-3:	Non-existent.
Section B-4:	Non-existent.
Section B-5:	Continued development and automation of diaphragms.

Section C-1:	Non-existent.
Section C-2:	Non-existent.
Section C-3:	Manufacture, development, and automation of the production of Standard Thiessen Barrier.
Section C-4:	Corrosion and passivation studies on barriers.
Section C-5:	Continuation of experiments as in C-4 and determination of reaction speed of uranium hexafluoride and water.

Section D-1: to D-5	Prepared design and technical drawings for apparatuses required by all other sections of the Thiessen department.

Section E-1: E-2:	Development of diaphragms by means of press and spray methods.
Section E-3:	Non-existent.
Section E-4: E-5:	Supervising other sections.

Section F-1: to F-5:

a. Development of measuring apparatus for determining gamma and delta gamma over gamma of diaphragms.

b. Development of apparatus for determining properties of metal powders by means of sedimentation.

c. Development of high-frequency sintering apparatus for use in manufacture of barriers.

d. Development of a separation stage for the determination of separation factor of diaphragms.

e. Measurement of the mechanical stability of diaphragms.

Section G-1: to G-5:

a. Experiments for the manufacture of metal diaphragms by means of electrolysis.

b. Designing accessory calculating device (slide-rule) for use with Pechukas and Gage apparatus.

c. Cathode dispersion and X-ray experiments.

Section H-1: to H-3:

a. Inorganic analyses.

b. Manufacture or organic barriers.

c. Development of fluorine generators.

d. Studies concerning H_2O evaporation and other distillation problems.

Section H-4: H-5:

Analytical investigations.

Section I-1: to I-5:

Performed precision machine work for all sections of the Thiessen department.

<u>Mitrenin Department</u> (1952-1955)

10. During fall 1952, Thiessen was transferred from Sinop to Elektrostal. He was accompanied by the following Soviet members of his department: Burdiashvili, Sokolova, and two others [redacted] 25X1 Thiessen was also accompanied by his German son-in-law Hermann Fritz Florek. At the same time Thiessen left Sinop, Yermin departed from Agudzeri, possibly to the same location as Thiessen. Thiessen took with him from Sinop all equipment and apparatuses which had been used for barrier manufacture. [redacted] 25X1

25X1

11. [redacted]

12. At the time that Thiessen was transferred, Prokudin, a Soviet member of the Thiessen department who from 1950 to 1952 had been carrying out the corrosion experiments [redacted] made preparations to transfer to an institute in Leningrad. [redacted] All the corrosion equipment was crated and was sent away; but at the last minute Prokudin was ordered to remain behind in Sinop. 25X1

13. Upon the departure of Thiessen, the department was placed under the Soviet Mitrenin. As far as the German specialists were concerned, the date of Thiessen's transfer coincided with the end of classified work. The Soviets had gradually removed the Germans from key projects as early as mid-1950. [redacted] Classified work in the most extensive sense of the word, [redacted] ended with the departure of Thiessen in fall 1952. The organization of the department of Mitrenin between fall 1952 and the time of the departure of the German specialists from Sinop in March 1955 was as follows: 25X1

Section	Functions	Personnel
Metallurgical I	Development of germanium and silicon monocrystals	28*, 30, 29, 51, 68
Metallurgical II	Manufacture and determination of properties of highly dispersed iron powder particles	5*, 25, 57, 69
Technology	Determination of physical properties of semiconductors developed in the Metallurgical I section	74* and two unidentified persons
Design Office	Design of apparatus required by other sections	75*
Physical Laboratory	Working in cooperation with Metallurgical I, this section made sintering experiments with germanium and silicon powders	4*, 9, 71

X-Ray Laboratory	X-ray studies, electron microscopy, and surface treatment of copper (electrolytic)	3*, 61, 72, 27, 7, 73, 64, 65
Chemical Laboratory	Analytical studies connected with distillation problems	2*, 54, 55, 62
Workshop	Prepared precision machine work for the entire department	8

Notes on Soviet Personnel

14. [redacted] Soviet personnel connected with the Thiessen department, [redacted] 25X1

Aksyanov (fnu) /possibly should be Aksyantsov/

Assigned to Metallurgical Laboratory of Thiessen Department; responsible for manufacture of sintering material. [redacted]

Assotiani, Yasha Rademovich [redacted]

Georgian. [redacted] 25X1

Burdiashvili, Shaley Savovich

Senior Scientific Associate. [redacted] 25X1

Frolova (fnu), Mrs.

Assigned to the fluorine analysis project in the chemical laboratory of the Thiessen department.

Gorizontov, /Boris Arkadyevich/

[redacted] 25X1

Kirvalidze (fnu) 25X1

Kandidat nauk [redacted] he was in Sinop as Senior Scientific Associate in Mitrenin's laboratory; [redacted]

Listopad (fnu), Mr. and Mrs.

[redacted] 25X1

Mr. Listopad was assigned to Prokudin's /q.v./ laboratory, while Mrs. Listopada worked [redacted] on the project for the improvement of tubular barriers by direct decomposition of nickel carbonyl. [redacted]

25X1

Lomadze, /Eteri/

Junior Scientific Associate. Assigned to chemical laboratory of the Thiessen department [redacted] 25X1

Mitrenin, Boris Petrovich

In 1952, he took Thiessen's post in Sinop. [redacted] 25X1

Oziashvili, Edika [redacted]

Worked on electron microscopy and X-Ray in the Thiessen department. [redacted] 25X1

Prokudin, Ivan Petrovich

[redacted] 25X1

Rudanovskiy (fnu)

Deputy department chief in Zavod 12, Elektrostal. [redacted] 25X1

PRELIMINARY RESEARCH ON DIFFUSION BARRIERS IN SINOP

15. [redacted] 25X1

16. No concrete technical requirements were announced by Thiessen in respect to the porous material, nor did he specify the type of material that was to be used. [redacted] the 25X1 leading members of the Thiessen group each chose or were assigned a method for development for which they were best qualified, based on their predilection or past experience:

a. Siewert: manufacture of organic diaphragms.

b. Wittstadt: manufacture of metal foils by an electrolytic process

c. Thiessen: pressed metal powder diaphragms.

d. Aksyanov (Soviet): manufacture of metal (probably copper) diaphragms.

e. Bartell: development of measuring apparatus to measure the porous materials produced by the separate sections; he first used the pressure-equalization method.

17. It was not until the end of 1946 that the technical requirements in the form of gamma and delta gamma over gamma specifications were made available. These were: gamma (permeability) equal to 0.8 to 1.2×10^{-3} and delta gamma over gamma (change in permeability) less than three percent. The delta gamma over gamma value was specified over a range from 15 to 65 mm of mercury. These requirements did not yet state that the diaphragms had to be metal, but simply specified "stability in respect to uranium hexafluoride." [redacted] this late 1946 definition of barrier properties in terms 25X1 of gamma and delta gamma over gamma did not have any effect on the preliminary program which had been started in May 1946.

18. A few weeks later (end 1946 to beginning 1947), however, Lt. Gen. Avraamiy Pavlovich Zavenyagin visited the Thiessen Department in Sinop and ordered that metal diaphragms be given preference over organic diaphragms. That is, they were to continue to make the porous dia-

phragms in the manner Thiessen had made them ever since May 1946. This was not because Thiessen's work was the most advanced in comparison with the other development projects listed above. On the contrary, [redacted] Siewert's organic work had progressed ahead of the sections using metallurgical approaches. In any event, the work on the organic diaphragms would have been seriously handicapped at this time, as Siewert and Thiessen had a personal falling out.[10] 25X1

19. Thiessen in his own laboratory, with his assistants, Miss Kittan (later Mrs. Srocke), Miss Schilling, and /Martin/ Krecker, continued to work on sintered metal-powder diaphragms by means of a pressing method. He used for this purpose a modified German press, not in excess of twenty tons, which had been used during the war to manufacture cartridge cases.

20. The other groups were reorganized. Soon not only Siewert's project but also Aksyanov's project was dropped. Burdiashvili and Ziegler began to manufacture nickel powder by the reduction method. [redacted] Bartell and Wittstadt continued with their old projects, the design and construction of measuring equipment and the development of barrier material by the electrolytic process, respectively. This was the division of the Thiessen department which lasted into 1948. 25X1

21. [redacted] 25X1

22. Thiessen obtained satisfactory diaphragms by means of the pressing process in spring 1947. [redacted] 25X1

-- [redacted]

10. [redacted]

11. [redacted]

12. [redacted]

[redacted] 25X1

23. [redacted]

24. [redacted]

25. [redacted]

STANDARD THIESSEN PRODUCTION BARRIER

General Description

26. At about the time (spring 1947) that the first pressed diaphragms were manufactured with nickel powder obtained from nickel carbonyl, the Thiessen department received additional technical specifications which included the required exterior dimensions for the barrier. [redacted] 25X1 Since these larger dimensions could not be obtained by the pressing method, Thiessen turned to producing barriers by a spraying process. Throughout 1947 and the early part of 1948, countless experiments were made in connection with this development until the optimum regimen was finally determined. It is very likely that sample barriers produced by the spraying method and representing the status of development as of a given time were sent outside Sinop for inspection. [redacted] 25X1 Sometime around 1947/1948, the order came for the production of 300 to 400 barriers by the spraying method. [redacted] 25X1

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13. After the development of the barrier proper in Sinop was completed, the specifications for gamma were raised. [redacted] 25X1

27. Working on a 24 hour a day schedule, the production section of the Thiessen department turned out the 300 to 400 barriers, which constituted a zero or test series. [redacted] 25X1 The barriers were individually wrapped in tissue paper and then placed in wooden boxes, each containing 100 barriers; wooden partitions formed sections holding 10 barriers each. Although throughout all of 1948, experiments were continued in the Thiessen department to improve the sprayed barrier /see pages 28-32 7, it was the barrier of this test series that was introduced into Zavod 12, Elektrostal, in June 1948. For this reason, it will be referred to in this report as the Standard Thiessen Barrier.

28. While the work to improve the barrier was in progress, occasional orders for additional series of the Standard Thiessen Barrier were received in Sinop. [redacted] between 1948 and 1949, 25X1 at least three or four series of 1,000 barriers each were produced in Sinop. On each occasion, personnel who had meanwhile been assigned to help in other sections of the Thiessen department or had been working on small experimental series in connection with the improvements were conscripted and for a short while worked under great pressure on a 24 hour per day schedule. Again it should be noted that these were series of the Standard Thiessen Barrier as it existed in the beginning of 1948 and as it was introduced in June 1948 in Zavod 12, Elektrostal; these series were not affected by the experiments, then in progress, aimed at improving this barrier.

29. [redacted] these production series were required to overcome critical needs of a cascade because of some mishap. [redacted] 25X1 the barrier in a cascade could easily be made unserviceable by opening a wrong valve, permitting the pressure across the barrier to become too high and causing a collapse of the tube. [redacted] 25X1

Flow Chart and Description of Production Steps

30. A flow chart identifying the thirteen separate steps in the production of the Standard Thiessen Barrier, as they were introduced in Zavod 12, Elektrostal, during the summer of 1948 is given below:

(1) Determination of nickel powder properties

(2) Preparation of the suspension

(3) Cutting of wire screen

(4) Electrolytic etching

(5) Spraying

(6) Rolling Step No. 1

(7) Sintering

(8) Rolling Step No. 2

(9) Cutting of the wire screen

(10) Intermediate measurement

(11) Welding of screen into tube

(12) Weighing of finished barrier tube

(13) Determination of permeability of barrier (gamma and delta gamma over gamma values)

31. Concerning these various production steps [redacted] 25X1

a. <u>Preparation of Wire Screen</u>

The wire screen used for the sprayed barrier in Sinop was supplied by an unidentified factory in East Germany. [redacted] 25X1 Everything pertaining to the wire-screen material was considered a matter of security, and was therefore handled by the <u>pervyy otdel</u> or security department in Sinop. [redacted] 25X1 In connection with occasional shortages of wire-screen material in Sinop, [redacted] 25X1 Col. Mikhail Mikhaylovich Kuznetsov of the Ninth Directorate had once traveled to East Germany in order to expedite shipment; [redacted] 25X1

During the experiments leading to the final Standard Thiessen Barrier, diverse wire screens with anywhere from 5,000 to 20,000 mesh per square centimeter were used. It was found that the 5,000 mesh was too coarse and resulted in the sinter mass falling out, while the 20,000 mesh was considered too expensive. It was finally decided to use 10,000 mesh wire screen. The diameter of this wire was recalled to be about .05 mm with an unknown tolerance. After early experiments at cutting the wire in the direction of the mesh, it was later decided to cut the screen diagonally as this produced greater stability. The screen was cut into rectangular sections, 15 cm x 55 cm, which was sufficient for two finished tubular barriers when the sprayed screen was cut again (step 9) and welded (step 11).

The rectangular section, 15 cm x 55 cm, was submerged into a bath of hydrochloric acid and was electrolytically etched so as to roughen the surface of the screen and to reduce its thickness. In arriving at a final specification for the etching phase, two diametrically opposed conditions had to be resolved: On the one hand, it was desirable to etch the wire to make it as thin as possible and, on the other hand, it was necessary to retain the stability of the wire screen. These experiments had been carried out in Wittstadt's laboratory, where two large rectifiers of 50 amperes each were available. [redacted] 25X1

b. Spraying Operation

A suspension of nickel powder in ethyl alcohol was sprayed upon the etched and dried rectangular screen. The nickel powder used in the suspension was classified in terms of its shaking weight and shaking volume, and later a particle size which characterized the nickel powder was determined by the Pechukas and Gage test method. [redacted] 25X1

c. Rolling, Sintering, and Welding Operations

After the suspension had been deposited on the etched wire screen, a few rolling passes were executed. The rollers used for this purpose were manufactured at Sinop but received their final machining in an unidentified plant in Tbilisi, as Sinop did not have any cylinder grinding machines. The number of passes for each rolling process was specified after experiments which determined how much rolling the mesh could safely stand and how much the volume available for sintered powder was decreased.

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After the first rolling step, the screen was sintered, in a sintering oven, in a reducing atmosphere of hydrogen. [redacted] the barrier was sintered for about one-half hour at a temperature of about 350°C.[14] 25X1

Before the screen was welded, it was subjected to an intermediate measuring test. For this purpose a Gamma Zange or gamma forceps was designed, with which it was possible to make quick spot checks of the screen and determine whether the barrier had been damaged in production, i.e., large holes formed, etc.

The rectangular screen was then cut into two equal parts which were welded into tubes. The cutting was performed with a simple cutter similar to a photo laboratory paper-cutter. As stated above, the initial requirements were simply in terms of external dimensions for a flat-plate barrier. Sometime in 1947, the Thiessen department was ordered [redacted] to produce tubular instead of flat-plate barriers.[15] 25X1

After attempts to solder the nickel wire screen were unsuccessful, it was decided to weld the screen. For this purpose, an electric welding apparatus was designed with which the flat plates, produced in the manner described above, could be welded into tubes. [redacted] the decision to weld the flat plates was an internal one at Sinop, and that the Soviet order had simply called for tubes. The finished tube had a length of 500 mm and a diameter of 15 mm. 25X1

[redacted] 25X1

d. End Pieces of Barrier

[redacted] it appears that the Standard Thiessen Barrier production process which was introduced into Elektrostal had no provision for mounting the barrier. [redacted] 25X1

25X1

e. Measuring Operation

When the Thiessen department first began to work on the development of porous material, Bartell and von Maydell began to design an apparatus with which to test permeability of this material. At first, an apparatus was constructed which made use of a pressure-equalization method. This apparatus, however, did not supply accurate data. In particular, the determination of the time element was inaccurate. In the beginning of 1947, at a time when Thiessen was still making diaphragms by the pressing process, the Soviets supplied a Flaechenmess-apparat (flat-plate measuring apparatus) to Sinop and probably also to Agudzeri. [redacted] 25X1

[redacted] The principal reason for supplying the measuring apparatus was to make sure that the same measurement criteria were used in Sinop as were used in other Soviet institutes. 16/ [redacted] 25X1

The Soviet-made flat-plate measuring apparatus was accompanied by approximately ten etalon diaphragms. These were standard or calibration diaphragms. The etalon diaphragms were made of nickel without wire-screen support, and had exterior dimensions of 10 cm x 15 cm which was approximately the size of the measuring apparatus. An etalon diaphragm had a greater thickness than the pressed diaphragms then made by Thiessen and was extremely brittle. [redacted] 25X1

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[redacted] 25X1

[redacted] 25X1

The Soviet measuring apparatus was used to measure the rectangular screens after the second rolling operation (step 8). Later, when the order for tubular barriers was issued, the Bartell section built another test apparatus making use of the same principles as the Soviet machine.

32. Concerning the permeability requirements of the barriers, it was already stated [see page 15] that the specifications were issued only towards the end of 1946. [redacted] 25X1

33. [redacted]

34. The barriers produced in Sinop at the end of 1947 or the beginning of 1948 satisfied the Soviet technical requirements. The rejection rate was negligible. The reason for this was that in the production series in Sinop each barrier could be treated individually, which was, of course, not the case when the barrier was produced on an industrial scale. Later, when the production process was transferred from the Sinop research institute to the Soviet barrier plant in Zavod 12, Elektrostal, the problem of rejects became significant [see pages 44-50]. [redacted] 25X1 practically all the rejects in the Soviet production plant were the result of excessively high delta gamma over gamma values rather than gamma values.

35. [redacted]

STATISTICAL SURVEY TO DETERMINE OPTIMUM PRODUCTION REGIMEN

36. Sometime in 1948, [redacted] a statistical survey of the Thiessen barrier production regimen. [redacted] The [redacted] aim of the study was to determine the optimum regimen for obtaining barriers with specified gamma and delta gamma over gamma values for use in mass production. It was a rather crude analysis of data and not a real statistical analysis in the orthodox mathematical sense of the term.

37. For every barrier that was produced in Sinop during this time, including the production series as well as those barriers produced in connection with studies for improvement of the barrier, a record was made. This information was [redacted] prepared on cards [redacted] The data included:

a. A number identifying the barrier

b. Powder used:

(1) Nickel carbonyl, reduction, or Monel powder.

(2) Particle size of powder as determined by the Pechukas and Gage method.

c. Quantity of powder per square centimeter sprayed on screen.

d. Number of mesh per square centimeter of screen

e. Etching treatment

f. Number of passes during first rolling step

g. Temperature and time of sintering

h. Number of passes during second rolling step

i. Thickness of finished barrier

j. Weight of finished barrier

k. Gamma and delta gamma over gamma values

38. The information on the cards was plotted graphically in a great number of ways. These graphs may be divided logically into two series. The first series of graphs showed how the thickness, final weight, and gamma and delta gamma-gamma values varied for changes in parts of the production regimen. The second series, which was produced after study of the first, showed the optimum regimen to be used for the production of barriers which would meet the technical specifications for a given powder quality. [redacted] 25X1 this second series of curves was developed for the use of relatively unskilled technicians; it was to be used in the factory to determine the parameters for the production of the Standard Thiessen Barrier.

39. [redacted] 25X1

40. In graph 1 on page 26, the particle size of the powder as measured by the Pechukas and Gage method is plotted against the optimum weight of powder per unit area which should be sprayed on the screen as the first step in the process to produce the Thiessen nickel-wire mesh barrier which would meet the specifications. [redacted] 25X1 a second curve could be plotted on the same graph for use with nickel powder manufactured by the reduction method.

41. The number of passes to be specified for the first rolling process was determined from Graph 2 on page 26. The values on the ordinate of this graph are identical with those on the abscissa of Graph 1.

42. The temperature at which the sintering oven should be set for the specified sintering time (one-half hour) was then determined from Graph 3.

43. The number of passes required in the second rolling is given in Graph 4 on page 26.

44. Similar graphs determined the current to be used in the etching process and the nozzle diameter and powder-to-alcohol ratio in the spraying process.

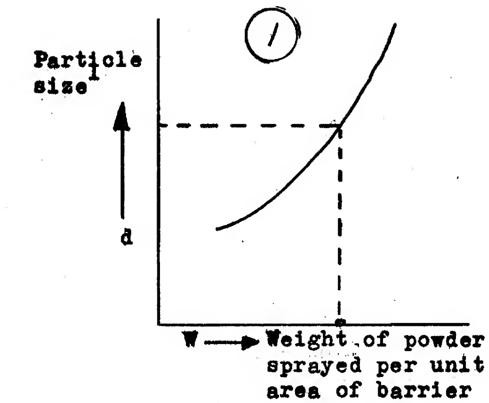
45. Over 90 percent of the barriers manufactured according to these directions lay within the specified values for gamma and delta gamma over gamma. For a specified range of gamma from 1.0 to 1.4 x 10^{-3}, the target value would be 1.2 x 10^{-3}.[17] In this case, over

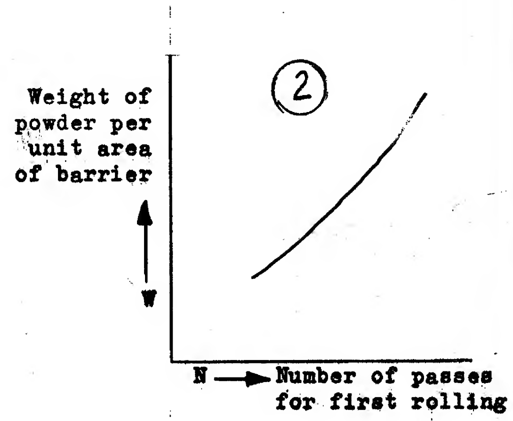
- - - - - - - - - - - - - -

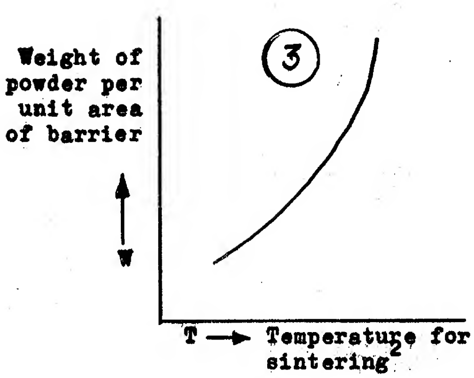
[redacted] 25X1

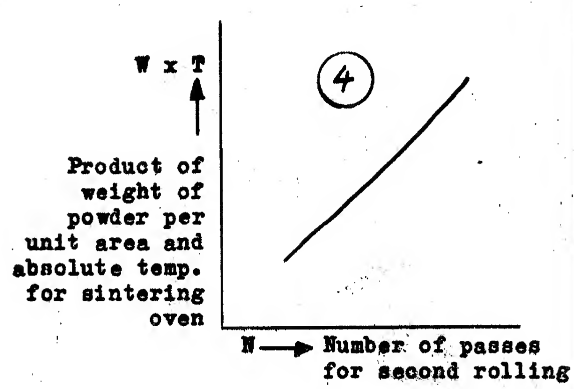
S-E-C-R-E-T

25X1









1. Particle size as measured by the Pechukas and Gage method.

2. The time of sintering was fixed at about one-half hour.

75 percent of the tubes would have gamma values between 1.1 and 1.3×10^{-3}, approximately 12 percent between 1.3 and 1.4×10^{-3}.

46. [redacted] 25X1 It is evident that lower delta gamma over gamma values are associated with lower gamma values. [redacted] 25X1 with very strict control of the process it would be possible to manufacture the Standard Thiessen Barrier with a delta gamma over gamma of two percent over a range of gamma from 1.0 to 1.4×10^{-4}, if a rejection rate of about 50 percent could be accepted. [redacted] 25X1 a lower delta gamma over gamma specification for tubes with an average gamma of 1.2×10^{-3} would be out of the question. None of the Standard Thiessen Barriers with gamma values of 1.0×10^{-3} or larger had a delta gamma over gamma of less than one percent.

EXPERIMENTS TO IMPROVE BARRIER QUALITY

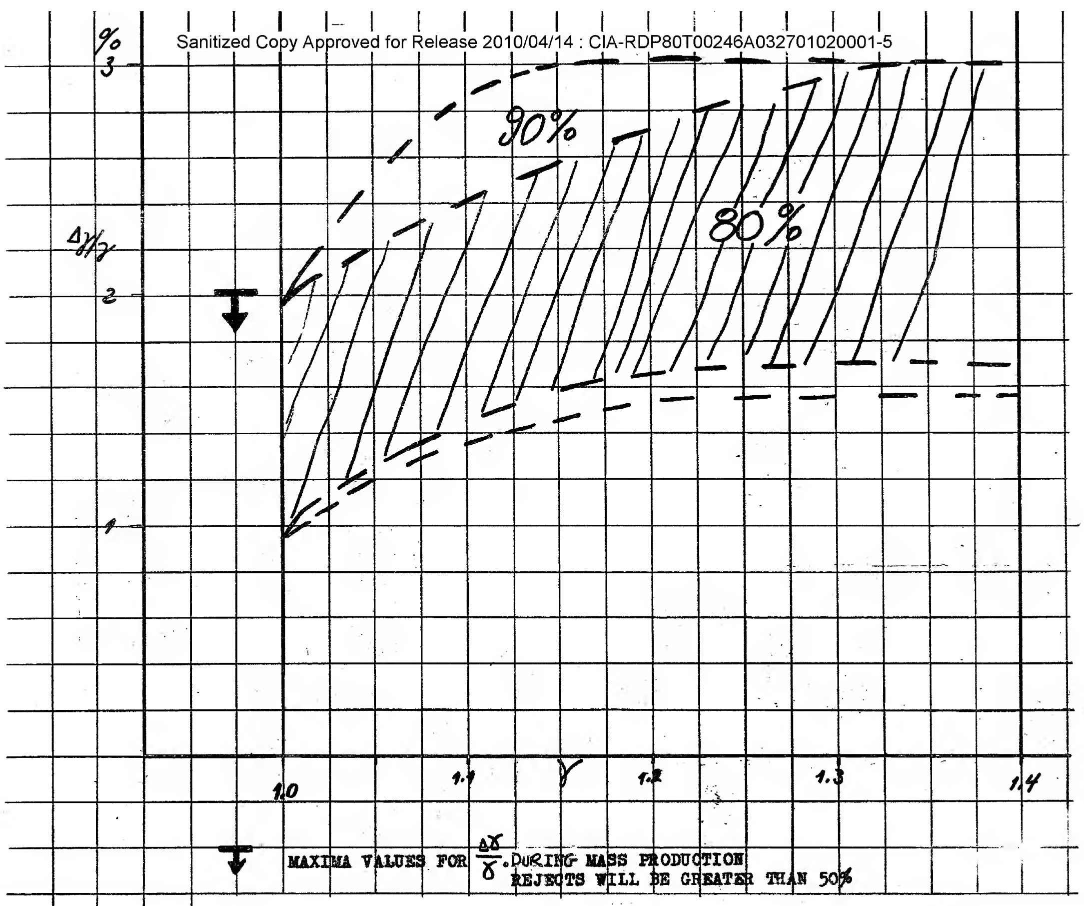
47. The Standard Thiessen Barrier had been successfully completed and the zero series approved by the beginning of 1948. During summer 1948, the manufacturing process for the Standard Thiessen Barrier was introduced into Zavod 12, Elektrostal, by a German group [redacted] 25X1

48. Also during 1948 and 1949, the Thiessen department received orders for three or four series of the Standard Thiessen Barrier of 1,000 barriers each [see page 18].

49. In addition to these production efforts, the Thiessen department, in 1948 and 1949, was engaged in work aimed at modifying or improving the Standard Thiessen Barrier. [redacted] 25X1

50. Most of the improvement work was a natural outgrowth of the barrier work that had been performed up to this time in Sinop, and the initiative was distinctly local. Within the framework of the Standard Thiessen Barrier project, it was hoped to simplify the technological production steps and also to improve the inherent characteristics of the barrier, such as the mechanical stability or the separation factor.

51. Some of the development tasks of this period were of a different nature. That is, the initiative came from outside Sinop. [redacted] 25X1



ESTIMATE OF DELTA GAMMA OVER GAMMA DISTRIBUTION
IN PRODUCTION OF THIESSEN TUBULAR BARRIERS.

S-E-C-R-E-T

[redacted]

25X1

52. **The barrier development tasks of this period are, therefore, listed under two categories:**

a. Experiments to Improve Standard Thiessen Barrier. The experiments or manipulations which aimed to improve the Standard Thiessen Barrier or its production process included the following:

(1) Variations of Rolling and Spraying Steps. Experiments were conducted in which the spraying and rolling processes were varied in order to determine the effect on barrier quality. These experiments included: spraying one side of the barrier only, leaving the other side of the screen bare; spraying a thin layer of powder on both sides of the screen; covering the screen with powder and then immediately sintering the mesh instead of first subjecting it to rolling.

(2) Butterbrot. Experiments were conducted in which a layer of coarse powder was sprayed on a wire screen, and over this a second layer of fine powder was sprayed. This development task was carried out by Krecker and Miss Schilling in the personal laboratory of Thiessen and went under the nickname (not an official code word) of Butterbrot. In some experiments, the first layer was sintered and rolled before the second layer was applied. [redacted] 25X1 The coarse powder was selected by the Pechukas and Gage method. In addition to using nickel carbonyl powder, obtained by altering the production regimen, reduction powder obtained locally and powder delivered from outside Sinop were used for the coarse powder layer. Measurements of the gamma and delta gamma over gamma value of the coarse layer were made with the Gamma Zange (gamma forceps). [redacted] 25X1 For the fine layer, the standard nickel carbonyl powder used in Sinop for the

[redacted] 25X1

Standard Thiessen Barrier was always used.[19] [redacted]

25X1

(3) Fahrstuhl. Two machines for treating barriers, making use of radio-frequency heating for sintering the barrier, were developed by Bartell and von Maydell. These machines were referred to as Fahrstühle (elevators), because the heating coil was moved swiftly over the vertically mounted barrier. [redacted] At high temperatures, there is a strong tendency for two small particles to coalesce to form one big particle which, of course, is disadvantageous for a diffusion barrier. [redacted]

25X1

25X1

- - - - - - - - - - - -

[redacted]

25X1

(4) Monel Powder. Ziegler developed a method to produce Monel powder by reduction. After Ziegler left Sinop in 1948, the experiments were continued by the Soviet Burdiashvili. [redacted] Monel was considered as an alternate to nickel because this copper-nickel alloy is cheaper than nickel. [redacted]

25X1

25X1

b. Variations of the Standard Thiessen Barrier

(1) Conic Barriers. The Thiessen department developed, presumably on the request of an unidentified installation outside Sinop, a sprayed barrier of conical shape. As the Thiessen department used the Standard Thiessen Barrier spraying process in this development, the task was simply and quickly accomplished. It was required only to design and construct larger welding machines. A small series of these conic barriers, [redacted] was produced in Sinop and sent to an unidentified installation. These barriers were not investigated for separation factor, as suitable separation stages were not available in either Sinop or Agudzeri. [redacted]

25X1

25X1

(2) Odd-Sized Barriers. Another task which, for reasons similar to those given for the conic barrier, must have originated outside Sinop called for the manufacture of two series of tubular barriers having odd-sized diameters between 30 and 35 mm and between 20 and 25 mm. In each case, a small series was manufactured and sent to an unidentified installation.

(3) Duplex Barrier. Still another barrier development task, which evidently was for an installation other than Sinop, called for the design of a duplex barrier. That is, two tubes were mounted concentrically. The inside tube had a diameter of 13 mm while the outside tube had a diameter of 15 mm. Again, a small series was produced which went to an unidentified installation.

c. Separation Tests of Modified Barriers. The above list is not exhaustive. Anywhere from 20 to 50 barriers were made as result of each of these experiments. These barriers were shipped away from Sinop. [redacted] None of these experiments led to any major improvement of the Standard Thiessen Barrier, and [redacted] none of the variations (for paragraph a) had been incorporated into the Soviet production program of the Standard Thiessen Barrier [redacted] Samples of the barriers, especially those listed under paragraph a, were sent to Bartell's laboratory, where a separation stage and equipment to measure the mechanical stability of the barriers was available. These improvements gave no changes in the gamma and delta gamma over gamma values as compared with the normal production series (i.e., Standard Thiessen Barrier) in Sinop. [redacted] In connection with Bartell's work, [redacted] the separation experiments were made with a mixture of carbon tetrachloride and benzol, and that the separation factor was determined by means of "zero density determination." That is, the density for two model gases taken separately was first determined. The gases were then condensed and mixed. Thereupon, the density of the mixture was measured. It was then possible to calculate the difference in density between the diffused and non-diffused gas.

25X1

25X1

25X1

25X1

AUTOMATION OF PRODUCTION PROCESS FOR STANDARD THIESSEN BARRIER

53. [redacted]

25X1

20.

[redacted] 25X1

54. Soviet Rudanovskiy worked on automation in Sinop from August 1950 to fall 1951. [redacted] 25X1 Rudanovskiy had been deputy director of the tsekh in which the Thiessen barrier was being introduced. [redacted] 25X1 When Rudanovskiy arrived in Sinop in August 1950, [redacted] his transfer had involved a demotion resulting from a scandal of some kind, [redacted] 25X1 Rudanovskiy was accompanied by an unidentified Soviet who was related to him by marriage. At this time, a special section was organized in the Thiessen department and was headed by the Soviet Prokudin; it was staffed only with Soviets.[21] The major preoccupation of this section was corrosion and passivation work. Rudanovskiy took charge of a subsection in the Prokudin section, and with a staff of approximately six other Soviets, including the aforementioned relative, worked on the problem of automatizing the production process for the manufacture of the Standard Thiessen Barrier. [redacted] 25X1 Rudanovskiy might have coupled this work with attempts to improve the Standard Thiessen Barrier.

55. [redacted] the laboratory was out of bounds to all Germans except Thiessen. 25X1 [redacted] an assembly line with a large number of rollers and rolling tables had been set up. To satisfy the space requirements for such an assembly line system, Rudanovskiy had been given a room at least 15 meters long in the basement of the Thiessen department's building in Sinop.

56. [redacted] 25X1

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21. [redacted]

22. [redacted]

57. [redacted] 25X1

58. The work of Rudanovskiy and his subsection continued until the middle or end of 1951, at which time Rudanovskiy and his relative left Sinop abruptly for an unidentified destination. Rudanovskiy's transfer was again accompanied by a scandal.23/

COMPETING TYPES OF BARRIERS DEVELOPED AT SINOP

59. The Standard Thiessen Barrier was not the only barrier designed or developed in Sinop between 1945 and 1955. Upon the crystallization of the Soviet specifications, the spraying technique of Thiessen became the nucleus of the development work, and evidently this technique was accepted by the Soviets as a solution for the barrier project when it was introduced into Elektrostal.

60. Once the barrier technique of Thiessen was accepted for production, however, at least two efforts were made at Sinop to develop different methods for manufacturing barriers. The aim was "simplifying, or rather reducing the number of manipulations; basic changes were made with the aim of getting away from inaccurate manual work by using machine operation." Neither of these efforts appears to have had at any time a priority (in terms of manpower or material) assigned by the Soviet administration in Sinop, and they can fairly accurately be described as the independent efforts of the Soviet Burdiashvili [redacted] 25X1

Ziehl's Barrier Development - Direct Decomposition Method

61. [redacted] 25X1

62.

- - - - - - - - - - - - -

23/ On Rudanovskiy's order, a Soviet laboratory assistant had attempted to desiccate in a vacuum drying oven a fairly large quantity of an unidentified explosive material. Soon after the material was placed in the oven and the bolts were secured, an explosion occurred which destroyed the vacuum oven and fatally injured a Soviet workman. An official investigation established Rudanovskiy's responsibility.

[redacted] 25X1

63. [redacted]

a. <u>Direct Deposition of Nickel Powder on Single Tubes.</u> [redacted]

[redacted] A screen was welded into a tube of required dimensions, and this tube was processed into a barrier as follows:

(1) The sketch on page 36 shows the equipment for the first steps of the process: In a vertically mounted cylinder (not shown) was placed the tube that had been welded from wire screen (Point 2). Within the screen was placed a glass tube (Point 1), and within the glass tube was located a heating coil (Point 3). The entire assembly could be rotated. The glass tube and the wire-screen tube were concentric, with a slight gap between the two walls. Into this gap was fed a mixture of nickel carbonyl and nitrogen (Point 4). The nickel carbonyl then decomposed directly inside and along the meshes of the heated wire screen to form nickel powder (Point 5) and carbon dioxide.

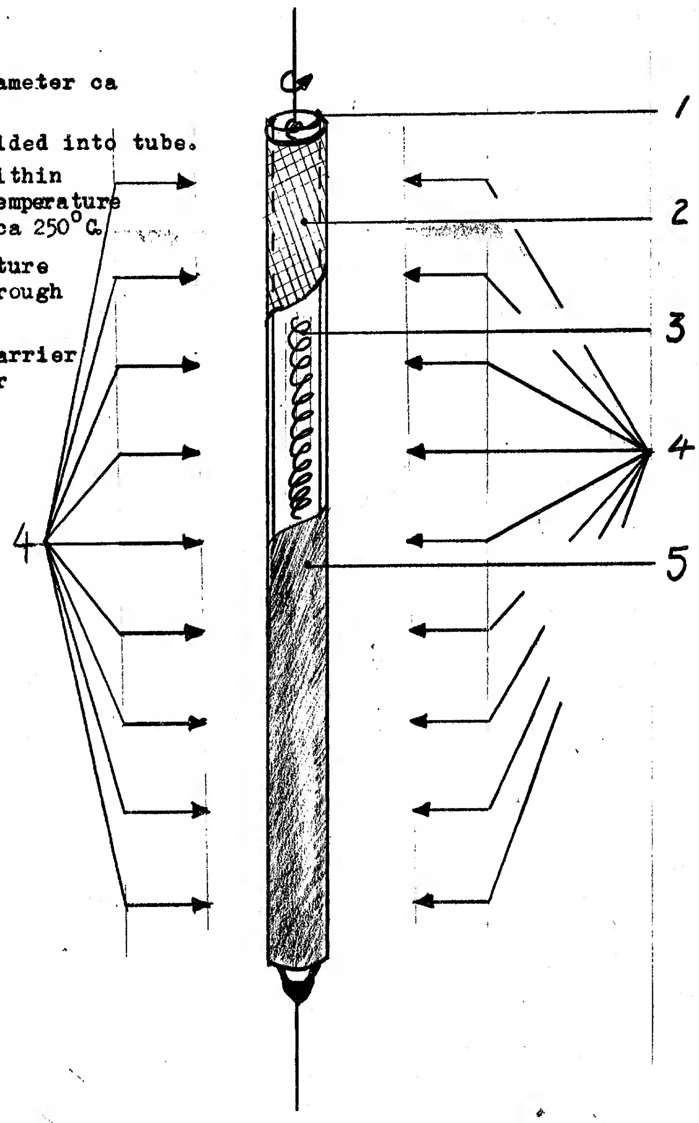
(2) In order to assure a uniform distribution of nickel powder along the screen, a pair of ventilators was placed in the gap between the glass tube and the screen tube to act as stirrers. The ventilators are not shown on the sketch.

(3) For the second step of the process, a planetary roller system was designed. Figure 1 on page 37 is a perspective view of the machinery when in operation. Figure 2 on page 37 shows the machinery when opened. The points described below refer to Figure 2 on page 37.

(4) Point 1 is a pressure roller which locks the tubular barrier (Point 3) in the roller frame (Point 2), which consists of two rollers rotating in opposite directions. Within the barrier tube was placed a solid metal rod, of slightly smaller diameter, called <u>Walzkern</u>, (Point 4). In order to take into account the expansion and the deformation of the barrier tube, a number of these <u>Walzkerne</u> were available, each differing in radius by

/Text continued on page 38/

1. Glass tube, diameter ca 10-12 mm.
2. Wire screen welded into tube.
3. Heating coil within glass tube. Temperature of glass wall ca 250°C.
4. $Ni(CO)_4$-N_2 mixture enters here through jets.
5. Wire screen (barrier material) after experiment.



APPARATUS FOR MANUFACTURE OF TUBULAR BARRIERS BY DIRECT DECOMPOSITION OF $Ni(CO)_4$-N_2 MIXTURE ON WIRE SCREEN TUBE

Planetary Roller System
Fig. 1 Opened
Fig. 2 Closed

1. Pressure roller.
2. Roller table.
3. Diaphragm on Walzkern.
4. Walzkern (different diameters available).

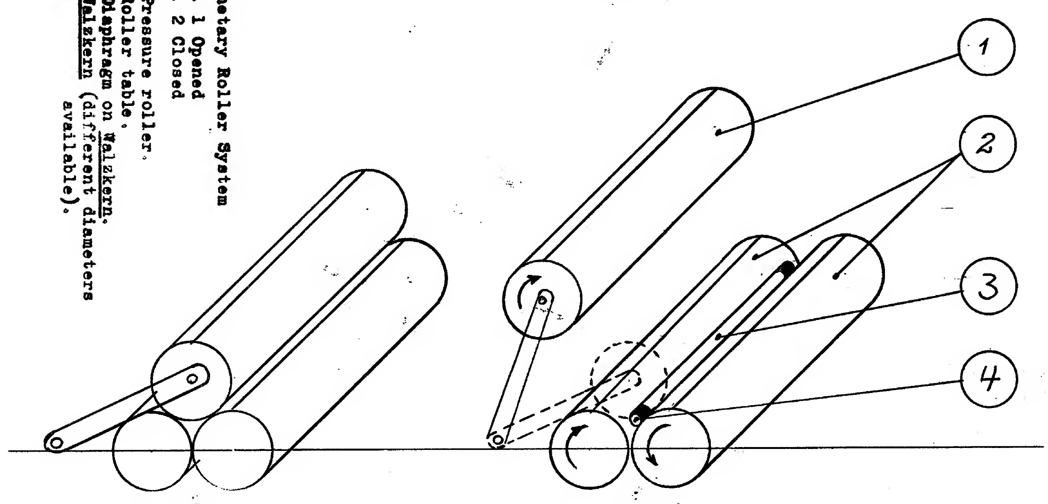


Figure 1   Figure 2

25X1

PLANETARY-TYPE ROLLERS USED IN CONNECTION WITH APPARATUS FOR THE MANUFACTURE OF TUBULAR BARRIERS BY DIRECT DECOMPOSTION OF $Ni(CO)_4$-N_2 MIXTURE ON WIRE SCREEN TUBE

0.1 mm. After a few passes, the Walzkern was withdrawn from the barrier tube, and the next appropriately dimensioned Walzkern was inserted into the tube.

(5) [redacted] this system could not work, as it was impossible to take account of the various deformations of the barrier tube. Because of the counterrotation of the two base rollers between which the Walzkern rested, the barrier tube always formed bulges which were then rolled flat. Consequently, the barrier always developed creases or was torn. 25X1

(6) [redacted] 25X1

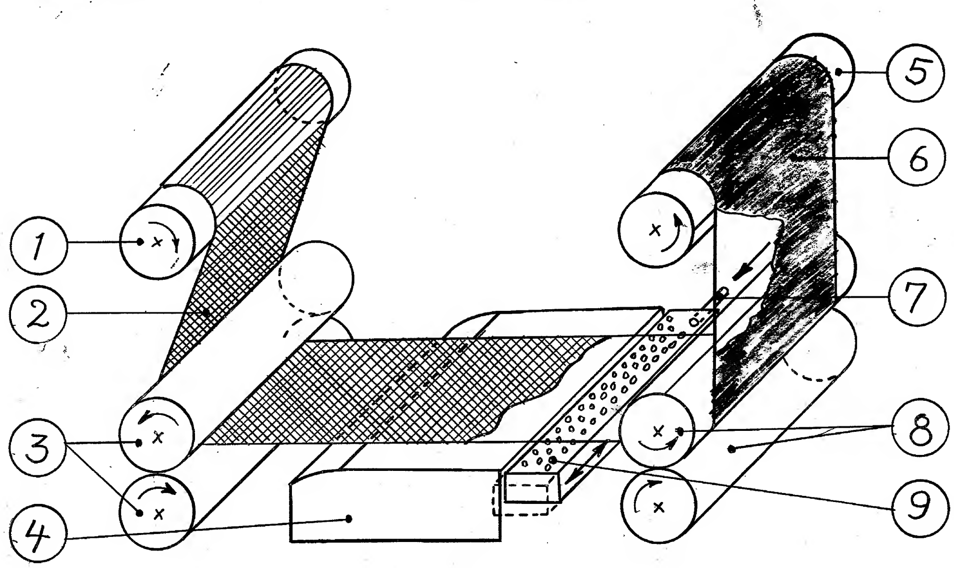
(7) This process did not provide for sintering. It was found that the direct decomposition would link the nickel particles sufficiently without sintering. The screen was heated and, as the first particles decomposed along the wire screen, each particle became heated and thus permitted another nickel particle to decompose on top of it. When these were rolled, the cohesive strength was believed to be sufficient.

(8) In addition to making sintering unnecessary, this system was thought to have another advantage in that it would yield a more favorable structure than was obtained with Thiessen's spraying method. [redacted] the nickel particles have a tendency, both in the generator and during the spraying process, to coagulate in a form similar to cotton batting, that is, they form a loose structure of indefinable shape. In the direct decomposition of nickel carbonyl, however, the cotton batting phenomenon hardly ever occurred, and if it did, the interconnected crystals were rolled into the meshes of the screen. 25X1

(9) The above experiments proved the feasibility of the principle of direct decomposition, even though it demonstrated the impracticability of the planetary roller system. This equipment was, therefore, discarded and was soon forgotten. The direct decomposition principle, however, was then transferred to equipment which could fabricate barriers continuously in the form of a running strip.

b. Running-Strip Process for Direct Deposition. This [redacted] making use of a running-strip system, was nicknamed locally "Pandora's Box." A perspective drawing of the system appears on page 39. 25X1

1. Roller with untreated wire screen [illegible] clutch.
2. Wire screen (ca. 25 cm wide)
3. Transport roller
4. Heating table (temp. below 400° C and [illegible]
5. Collector roller for finished barrier material
6. Barrier material



SCHEMATIC OF APPARATUS USED IN RUNNING STRIP PROCESS FOR DIRECT DEPOSITION OF $Ni(CO)_4$-N_2 MIXTURE ON WIRE SCREEN.

7. Tube through which the $Ni(CO)_4$-N_2 mixture enters
8. Pressure and transport roller, synchronized with roller (Point 3)
9. Jet device; moves in direction of arrows by a distance equal to distance between jets and with a frequency of less than 50 cycles.

S-E-C-R-E-T

S-E-C-R-E-T

25X1

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(1) A strip of wire screen of the same specifications as that used for the Standard Thiessen Barrier was "etched" and then was wound onto a run-off spool (Point 1). This run-off spool was equipped with a slipping clutch. The nickel wire screen (Point 2), which had a width of approximately 20 or 25 cm, was slowly unrolled by the driving rollers (Points 8 and 9). The speeds of all rollers were synchronized. While passing between the rollers (Point 3) and rollers (Points 8 and 9), the wire screen passed over a heated plate (Point 4), which was kept at a temperature which was above 200° C and below 400° C. After passing over the heating plate, the wire screen passed over an arrangement of jets (Point 9), from which fine streams of nickel carbonyl and nitrogen emerged. There were at least 20 jets. The distance between the jets of the same row was roughly 10 mm. The jet device moved in the direction indicated on the sketch and with an amplitude equal to the interval between the jets. There may also have been an added elliptical movement. The frequency of the oscillation was below 50 cycles per second. [redacted] 25X1 The purpose of the movement was to obtain uniformity of the sprayed layer. [redacted] 25X1 The jets in the spraying device were externally cooled with water.

(2) The wire screen (Point 6), on which the nickel powder had been deposited by decomposition of the nickel carbonyl, then passed through the rollers (Point 8 and 9) and was wound on the collector roller (Point 5).

(3) If a sufficient quantity of nickel powder was not deposited on the first run through the apparatus, it was possible to send the roll of wire screen once again through the entire process.

(4) [redacted] 25X1 The wire screen moved at a speed of about one millimeter per second over the jet device, or about three meters per hour.

(5) The process did not provide for a sintering step. This was not thought to be required, but such a step could easily be added to the process without loss to the automatic character of the machinery. [redacted] 25X1

(6) [redacted] 25X1

In some respects, the mechanical properties of this barrier material were superior to those of the Standard Thiessen Barrier. This was especially true of its ductility. The powder clung so hard to the wire screen that it would not fall off when the wire was vigorously bent back and forth, whereas with the Standard Thiessen Barrier such a procedure would leave a bare wire screen. [redacted] 25X1

(7) [redacted] this development was very promising, although no tubes had as yet been welded. Suddenly, the entire project was halted, with the explanation that wire-screen material was in short supply. In spite of reports on this project, [redacted] 25X1 the Soviets never evinced interest in the project. Thiessen's role was somewhat more ambiguous. 25/ [redacted] 25X1

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[redacted]

[redacted] 25X1

Burdiashvili's Barrier Development - Sedimentation Method

64. [redacted] Burdiashvili, [redacted] 25X1
attempted to design barriers using the sedimentation method. [redacted] 25X1
Burdiashvili came to the sedimentation process simply in an effort to find a method to replace the spraying of nickel powder suspension, which was a disagreeable and unhealthy procedure.

65. [redacted] Wire 25X1
screens which had been etched and rolled were placed at the bottom of a rectangular copper vessel, approximately 60 cm x 60 cm x 12 cm. The wire screen was then covered to a depth of 10 cm with a suspension of methyl alcohol and nickel powder. The nickel powder settled on the wire screen through gravitational pull. The vessel was then slowly drained of the methyl alcohol by means of an outlet provided on the bottom of the vessel. The operation lasted about one hour. After the one-hour sedimentation process, the wire screen bore a more or less uniform layer of nickel powder. The screen was then dried, rolled, sintered, and measured for its permeability characteristics. [redacted] 25X1

66. [redacted] ethyl alcohol could have been used instead 25X1
of the methyl alcohol, and [redacted] it would have the advantage of being less poisonous; but for reasons of economy, Burdiashvili chose methyl alcohol. The nickel powder used in this sedimentation process was obtained by the reduction method. This is not because the technique required the use of reduction powder instead of nickel powder from nickel carbonyl, but rather because nickel powder from nickel carbonyl was generally in short supply. All the powder produced from nickel carbonyl at that time was required for the spraying method. [redacted] 25X1

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26. In 1946 and 1947, [redacted] Burdiashvili worked on the production of nickel powder by a reduction method. [redacted] 25X1

67. [redacted] Like the Butterbrot barrier, sedimentation entails first a coarse powder layer on which a fine-grained powder layer is deposited. But [redacted] less defined in the sedimentation process (a) because of the very thin coating and (b) because of the elementary magnetism of the nickel powder. Though this elementary magnetism is very small for nickel powder, it nevertheless causes the larger particles to carry along the small particles, so that the medium sized particles settle on the entire surface area. [redacted] 25X1

68. A few hundred barriers of this type were made. Burdiashvili had as many as 50 of the rectangular copper vessels in operation. It was found that the barriers were superior to the Thiessen sprayed barrier in respect to uniformity. [redacted] the disadvantage of the Burdiashvili process was that the barrier was covered with nickel powder on only one side. This led to a lower stability of the barrier tube. [redacted] 25X1

69. The Burdiashvili barrier fully satisfied the technical requirements of the Soviets in respect to gamma and delta gamma over gamma. In fact, their delta gamma over gamma was better by about 0.5 percent, that is, 2.5 percent instead of three percent for the Standard Thiessen Barrier. The gamma value was around 1.0×10^{-3}. 27/

[redacted] 25X1

70. In the midst of the development work, [redacted] 25X1 the screen material was not available, the experiments were halted. Thiessen had shown very little interest in this work, although the top Soviet administrative official in Sinop, Gen. Kochlavashvili, was supposed to have been interested. 25X1 [redacted] Thiessen might have feared the competition of Burdiashvili and perhaps disparaged the work for not wholly disinterested motives. [redacted] 25X1 In 1951, Burdiashvili was honored with a collective Stalin Prize, First Class. [redacted] Thiessen, as well as two Soviets Trubnikov (fnu) and Olshevskiy (fnu), probably from Elektrostal, were also included in this collective Stalin Prize. [redacted] 25X1

71. After this project was discontinued, Burdiashvili worked on spraying processes with reduction powder and Monel powder [redacted] 25X1 Towards the end of 1952, Burdiashvili left Sinop with Thiessen, and returned again in January 1955. [redacted] 25X1

PROCESSES FOR SALVAGING PRODUCTION REJECT BARRIERS

72. [redacted] 25X1 the problem of salvaging reject barriers, [redacted] The problem consisted of taking finished production barriers with delta gamma over gamma or gamma values outside the range of the technical requirements and of devising measures which would bring the characteristics of these barriers into the specified range.

73. [redacted] 25X1

 [redacted] 25X1

[redacted] 25X1

74. The problem involved was twofold:

a. Given tubes with delta gamma over gamma values higher than the specified limit -- to lower these delta gamma over gamma values.

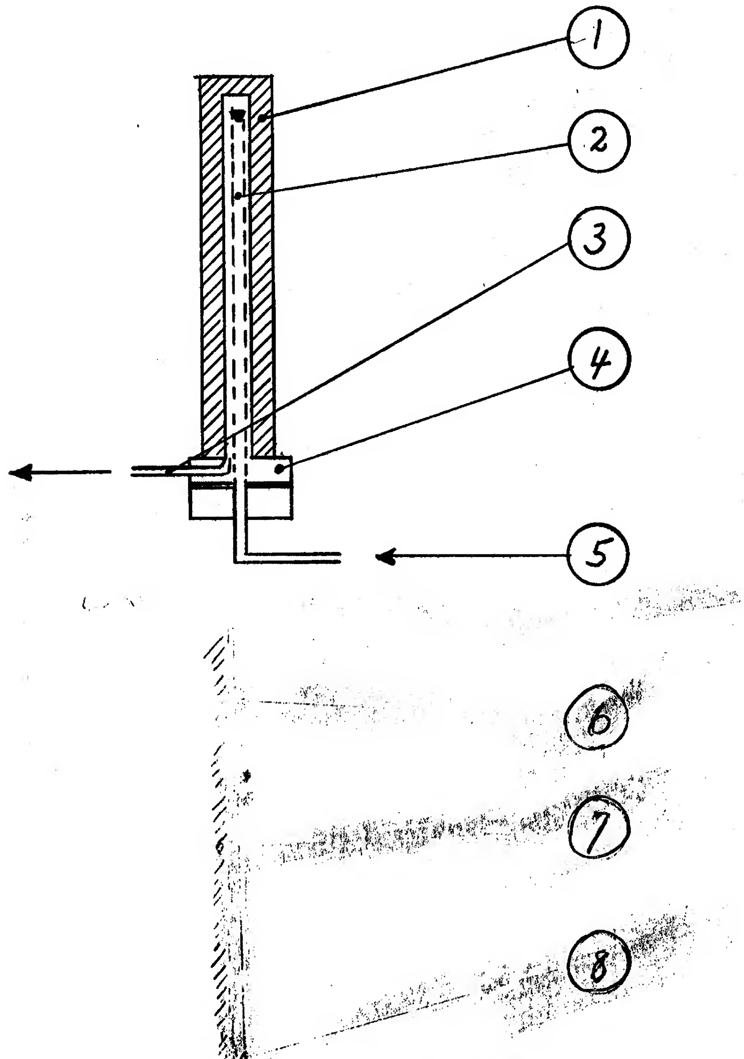
b. Given tubes with gamma values lower than the specified limit -- to raise these gamma values.

Lowering Delta Gamma over Gamma

75. If a factory mass-produced barrier had a delta gamma over gamma reading in excess of three percent, and if this was not caused by one large hole, it was possible to bring the barrier into the range of the specifications by means of the apparatus which appears on page 46. [redacted] 25X1 The apparatus made use of the principle of direct decomposition of nickel carbonyl on the barrier:

- - - - - - - - - -

[redacted] 25X1



APPARATUS FOR SALVAGING PRODUCTION
BARRIERS REJECTED BECAUSE OF
EXCESSIVE DELTA GAMMA OVER GAMMA

a. Point 1 is an electrically heated oven insulated with asbestos, which was kept at a temperature higher than 200°C and lower than 350°C. Into this oven was placed the barrier (Point 2), which was plugged at one end. Point 3 is an exhaust tube, and Point 4 is a cooled flange.

b. A mixture of nickel carbonyl and nitrogen entered the tube (Point 5). The mixture was at a pressure of 30 to 40 mm, and as it passed through the warmed diaphragm, the nickel carbonyl decomposed in the pores of the barrier. The control of pressure was important because of the rapid (quadruple) splitting-off of the CO molecules from the nickel carbonyl. [redacted] 25X1
[redacted] no pressures in excess of 50 mm were used. Experiments were also made at very low pressures; i.e., 10 mm or 20 mm. [redacted] 25X1

76. The nickel carbonyl decomposed as a wedge-shaped layer with the thicker part at the bottom of the tube. It was, therefore, decided to rotate the barrier by 180 degrees in the middle of the operation. Thus, the end of the barrier which pointed upward during the first half of the operation was pointed downward during the last half of the operation. In this way, a fairly uniform layer of nickel powder was deposited on the surface. [redacted] 25X1

77. As was expected, the larger part of the nickel carbonyl passed through the big pores; the smaller part passed through the smaller pores, thus reducing gamma and improving delta gamma over gamma. [redacted] experiments showed that any barrier could be 25X1
brought into the required norm range if the excess delta gamma over gamma was not caused by a single hole or a few large holes. This treatment of the barrier only very slightly decreased the gamma value.

78. After successful experiments [redacted] 25X1
[redacted] constructed another apparatus on the same principle but capable of holding five or six or eight tubes at one time. This larger apparatus operated automatically; that is, the valves in the system were electromagnetically actuated and were controlled by an electric programming system. During this operation, a valve placed at the entrance was closed. When a definite pressure was obtained, a magnetic valve opened the entrance for a specified time to let in a specific volume of nickel-carbonyl and nitrogen mixture. This volume was, of course, dependent on the concentration of the mixture. This cycling continued automatically for about one hour. A selector dial on the apparatus made it possible to select in advance the regimen desired; that is, the time the exhaust valve and the inlet valve were to be opened could be programmed.

79. The reason for the lengthy operation was that it was found undesirable to feed nickel carbonyl into the apparatus either continuously or in great quantities at one time. This [redacted] would lead to a sudden decomposition which would not settle in the pores of the barrier. Therefore, small quantities were sent through at frequent intervals and over a lengthy (one hour) period. This was another reason why low pressures were preferred. [redacted] Studies to determine the amount of nickel carbonyl that decomposed on the barrier were carried out [redacted] Attempts to determine this quantity by differential weight tests were unsuccessful because of insensitivity of the available apparatus. Finally, the following calculation was used: The initial weight of the nickel carbonyl-nitrogen mixture and its concentration were known. Also the initial pressure was recorded. The difference between initial and final pressure was the pressure that had been applied to the barrier. From this, it was possible to calculate the amount of nickel carbonyl decomposition for the ideal case in which all the nickel was decomposed along the barrier. 25X1 25X1 25X1

80. [redacted]

81. [redacted] 25X1

82. [redacted] 25X1

Increasing the Permeability of the Barrier

83. Increasing barrier permeability was simply a matter of making small pores bigger. The apparatus [redacted] for this purpose was very simple, and no sketch is supplied. The apparatus made use of the following principle: 25X1

a. At a temperature of approximately 60° C, nickel carbonyl was formed from nickel and carbon monoxide. A tube with low gamma values was placed in a glass tube which served

[redacted] 25X1

as a so-called cooling jacket. The cooling jacket, in turn, was connected with a Hoeppler thermostat, which kept the temperature somewhere between 60° C and 80° C. The heating was not performed with radio frequency but was water heating.

b. At a place of negative pressure, carbon monoxide was introduced, which entered through the pores of the barrier tube. The nickel carbonyl, which was formed as result of the interaction, deposited on the bottom of the device. It was found that more of the gas streamed through the larger holes of the barrier tube, with the result that the larger pores became larger at a faster rate than the small pores of the barrier. This led to a rapid increase in the delta gamma over gamma value, far beyond the permitted specification range, while the gamma value increased relatively slowly.

84. The experiments were carried out shortly before Thiessen's departure from Sinop in late 1952. [redacted] 25X1 Thiessen included it in the inventory of equipment which accompanied him to Moscow.

INTRODUCTION OF STANDARD THIESSEN BARRIER INTO SOVIET PRODUCTION

Experimental Tsekh in Zavod 12, Elektrostal

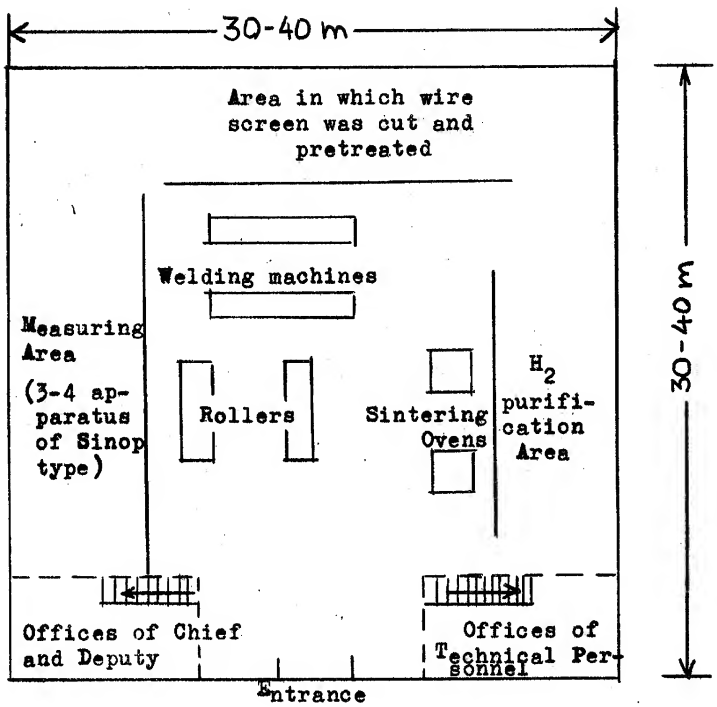
85. In spring 1948, after the first zero series of 300 to 400 Standard Thiessen Barriers had been manufactured in Sinop, a group of Soviet engineers from Elektrostal arrived in Sinop. [redacted] 25X1 While there, the group was assigned to the Thiessen department and was instructed in all phases of the production of the Standard Thiessen Barrier.

86. In the beginning of June 1948, a group of German specialists from the Thiessen department in Sinop was sent to Zavod 12, Elektrostal. [redacted] 25X1 Until the end of August 1948, they remained in Elektrostal and introduced the process for the manufacture of the Standard Thiessen Barrier.[30]

- - - - - - - - - - - -

30. Not all the Germans stayed for the eight weeks. It appears that Thiessen, Krecker, and Miss Schilling left before the end of August. Hartz, too, left earlier for Sinop, but returned again [redacted] 25X1

87. The Germans performed their work in a small building which served as an experimental plant. The official term for the building was tsekh. [redacted] 25X1



FLOORPLAN OF EXPERIMENTAL TSEKH, ELEKTROSTAL

88. In the building was exactly the same type of equipment as that used in Sinop for the production of the Standard Thiessen Barrier except that the numbers of every machine or device was multiplied by a factor of four to six. The machinery, with the exception of the sintering ovens, had been built in Sinop. [redacted] 25X1

89. [redacted] 25X1
In front of each building in Zavod 12 was a guard admitting only those who could identify themselves as having access to that particular building. [redacted]

90. [redacted]

91. 25X1

92.

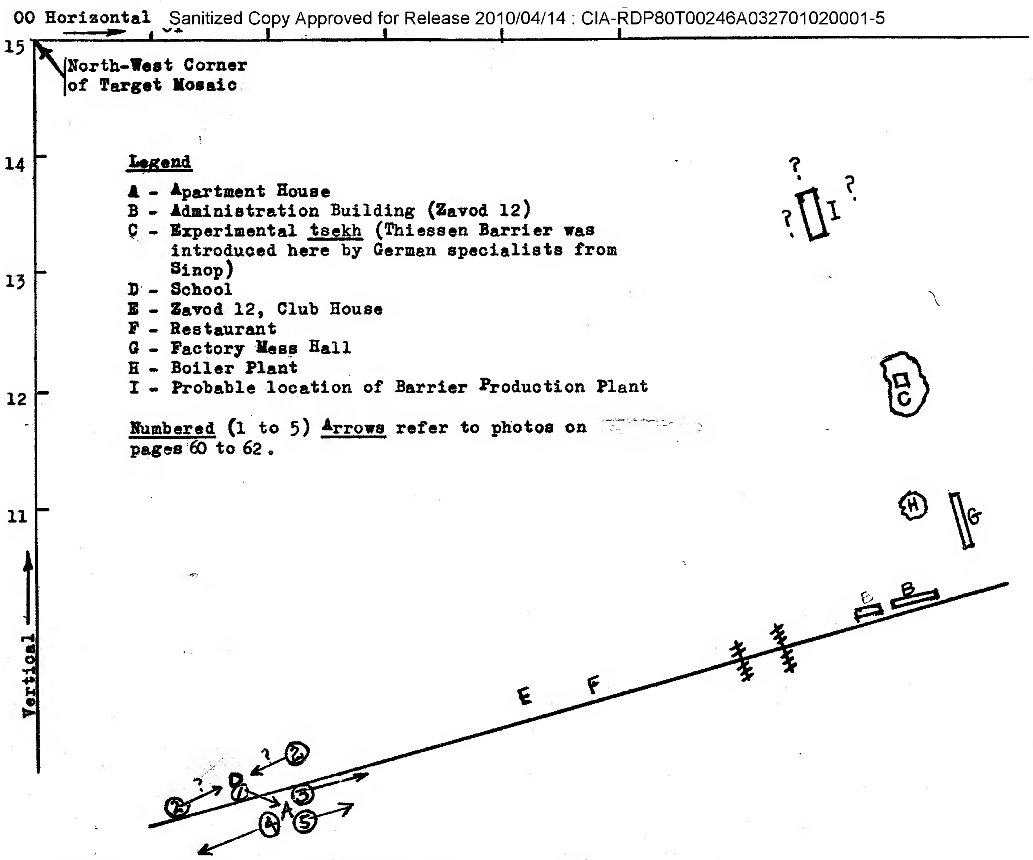
[redacted] Galovanov (fnu) was the chief engineer of Zavod 12. [redacted] the experimental tsekh was [redacted] subordinated to the Ninth Directorate of the MVD, and [redacted] the entire Zavod 12 was probably connected with that Directorate. [redacted] prior to beginning work in Elektrostal, the group of Germans from Sinop was briefed by high Soviet officials of the Ninth Directorate in Moscow. These officials included Gen. Zverev and Col. Kuznetsov. [redacted] 25X1

25X1

93.

31.

32.



LOCATION OF ZAVOD 12, ELEKTROSTAL

[redacted]

25X1

S-E-C-R-E-T

[redacted]

25X1

25X1

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104. [redacted] 25X1

105.

106. The following photographs show buildings and sites in the immediate vicinity of Zavod 12 in Elektrostal. The approximate position of the sites depicted may be obtained with reference to the overlay of Zavod 12 appearing on page 55 on which the photographs are indicated by arrows:

Photo 1: Apartment house or guest house of Zavod 12 in which [redacted] German specialists from Sinop were housed during their 1948 assignment in Elektrostal. 25X1

Photo 2: A school in Elektrostal. [redacted] 25X1

Photo 3: Ulitsa Karla Marksa. This asphalted street led east from the guest house (1) to Zavod 12.

Photo 4: View west-southwest from guest house (1)

Photo 5: View east from guest house (1).

- - - - - - - - - - - - - - -

[redacted] 25X1

S-E-C-R-E-T

25X1

1

2

S-E-C-R-E-T

S-E-C-R-E-T

25X1

3

S-E-C-R-E-T

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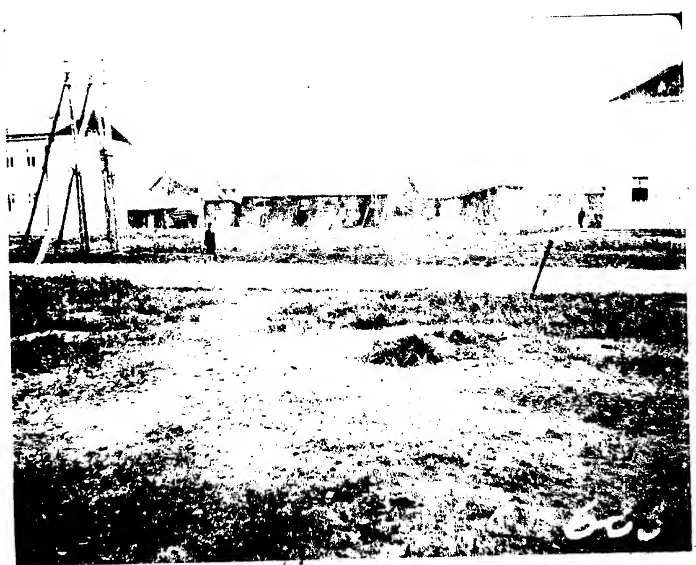
S-E-C-R-E-T

25X1



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5

S-E-C-R-E-T

65

INFORMATION REPORT INFORMATION REPORT

CENTRAL INTELLIGENCE AGENCY

S-E-C-R-E-T

25X1

COUNTRY	USSR (Abkhaz SSR)	REPORT	
SUBJECT	Development of Barrier for Gaseous Diffusion in Sinop from 1946 to 1952	DATE DISTR.	20 February 1957
		NO. PAGES	63
		REQUIREMENT NO.	RD
DATE OF INFO.		REFERENCES	
PLACE & DATE ACQ.			

25X1

25X1

SOURCE EVALUATIONS ARE DEFINITIVE. APPRAISAL OF CONTENT IS TENTATIVE.

25X1

S-E-C-R-E-T

25X1

STATE	#X	ARMY	#X	NAVY	#X	AIR	#X	FBI		AEC				

(Note: Washington distribution indicated by "X"; Field distribution by "#".)

INFORMATION REPORT INFORMATION REPORT

25X1

S-E-C-R-E-T

REPORT

COUNTRY	USSR (Abkhazskaya ASSR)	DATE DISTR.	11 Jan 57
SUBJECT	Development of Barrier for Gaseous Diffusion in Sinop from 1946 to 1952	NO. OF PAGES	62
PLACE ACQUIRED		NO. OF ENCLS. (LISTED BELOW)	
DATE ACQUIRED		SUPPLEMENT TO REPORT NO.	
DATE OF INFORMATION			

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THIS IS UNEVALUATED INFORMATION

S-E-C-R-E-T

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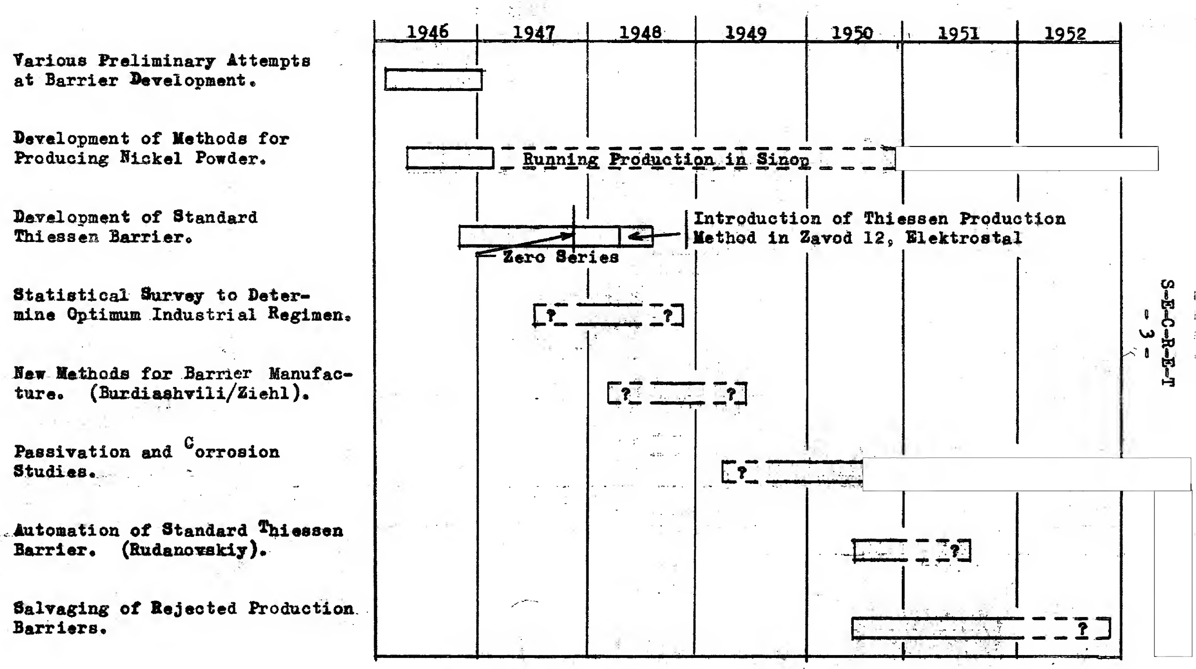
S-E-C-R-E-T

TIME TABLE FOR GASEOUS DIFFUSION BARRIER

DEVELOPMENT IN SINOP



25X1

25X1

S-E-C-R-E-T

[redacted]

INTRODUCTION

1. [redacted]

2. Until 1952, the highest authority of the combined Sinop and Agudzeri institutes was Gen. Aleksandr Ivanovich Kochlavashvili, who was succeeded for a short time in 1952 by Col. Lordkipanidze (fnu); sometime in 1952, this office was abolished. [redacted] Kochlavashvili's official title was Plenipotentiary of the Council of Ministers. He appeared to act as liaison between Sinop and the highest supervising echelon in Moscow, as well as between Agudzeri and Moscow. When the Sinop and Agudzeri institutes were combined in 1950, the first director of the combined institutes was Vladimir Vasilyevich Migulin, a physics professor from Moscow University. Most of the administrative sections in Agudzeri were moved to Sinop, and only branch administrative offices were maintained in Agudzeri; administration was under the Soviet deputy for administration, Petr Varlamovich Chelidze. The scientific technical offices in Agudzeri and Sinop were under two deputies for technical matters, Boris Mikhaylovich Isayev (First Deputy Director) in Sinop and Ilin Filippovich Kvartskhava (Second Deputy Director) in Agudzeri. The divisions of responsibility between the two deputy technical directors was not made on the basis of geographical location alone. Kvartskhava was responsible for some departments in Agudzeri but also for at least one department in Sinop, viz., the Thiessen department. Likewise, the department of Werner Schuetze[1] in Agudzeri was not responsible to Kvartskhava but to Isayev who had his office in Sinop. Evidently the division between the two deputies was on the basis of scientific fields, with Kvartskhava supervising departments with an emphasis on chemical science, whereas Isayev supervised departments with a primary emphasis on physics.

ORGANIZATION OF THE THIESSEN DEPARTMENT FROM 1946 TO 1952

3. The work of setting up Sinop Institute and the Thiessen department began in fall 1945 and continued through spring 1946. A few Germans, however, had already begun minor research tasks. [redacted]

[redacted]

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4. On 10 May 1946,[2] conferences took place in Sinop at which each department, i.e., that of Thiessen, Max Steenbeck, and Manfred von Ardenne, was given its assignment for the next years. [redacted] 25X1

5. Three leading Soviet scientists participated in these conferences. They had been in Sinop for some time in 1946, and had assisted the three German department chiefs in setting up the institute. [redacted] the name of the scientist who assisted von Ardenne, viz., Bonch-Bruyevich (fnu). [redacted] the scientist who assisted Thiessen was elderly, was balding, and had one or two prominent swellings on his head. 25X1

6. As a positive incentive, the Germans were shown a table on which a premium or award was listed for each task. It was during one of these conferences that the Thiessen department was given the project of developing barriers for gaseous diffusion. [redacted] 25X1

7. The Thiessen department worked on the barrier project from 1946 to 1952, although the problem of producing a workable barrier had been essentially solved by 1948. During these years, the Thiessen department was organized as shown on the chart on page 6.

Key to Organization Chart

8. [redacted] 25X1 The function of the various sections during the different periods will be tabulated below. The personnel have been listed by numbers: the numbers 1 to 32 apply to German nationals; the numbers 50 and higher apply to Soviet nationals; an asterisk beside a number indicates the head of the section.

Personnel [numbers refer to the organizational chart on page 6][3]

1	Prof. Peter Adolf Thiessen	[redacted]
2	Dr. Gerhardt Siewert	
3	Dr. Werner Wittstadt	
4	Dr. Hans Bartell	
5	Ludwig Albert Wilhelm Ziehl	
6	Wilhelm [Willi] Lange[4]	
7	Erich Wilhelm Franke	
8	Wolfgang Friedrich Srocke	
9	Werner Siegling	
10	Kurt Heptner	
11	Irmgard Schumacher (née Striepling)[5]	[redacted]

25X1

- - - - - - - - - -

[redacted] 25X1

3. Numbers 69 to 75 and No. 29 appear only on the chart of the organization of the department under Boris Petrovich Mitrenin given on page 11 below.

[redacted] 25X1

25X1 [redacted] 25X1

S-E-C-R-E-T

SECTIONS	1 Mid-1946	2 End-1946	3 1947/48-1948/49	4 1949 to Aug.1950	5 Aug.1950-End-1952
(A) Metallurgical Lab I	50*	16*,51,21,68	51*,21,68,	51*,21,68,	51*,68
(B) Metallurgical Lab II	///	5*,26,15	///	///	63*,67,64
(C) Technological Section	///	///	5*,12,13,14,19,20,23,24,25,52,55,56,57,60,61,8,9,15,26	5*,54,55,25,58,56,57,10,23,24,26	54*,55,25,10,57, 5,58,59,60
(D) Design Section	6*,11	6,11	22*, ?	22*,26	22*,26
(E) Thiessen's Private Laboratory	1*,13	1*,12,13,14,	///	1*,13	1*,13
(F) Physical Laboratory	4*,12	4*,18,19 20	4*,18	4*,18	4*,9
(G) X-Ray Laboratory	3*,7,10,	3*,7,10,64	3*,10,27,65,66	3*,27,7,31,32	3*,7,27,
(H) Chemical Laboratory	2*,5,26	2*,52,53,26,55,31,32	62*,31,32	62*,61,52	62*,61,52
(I) Workshops	8,9	8,9	? ?	8,9	8

ORGANIZATION CHART OF THIESSEN DEPARTMENT

S-E-C-R-E-T

[redacted] 25X1

12 Susanne Srocke (née Kittan)
13 Ingrid Schilling[6]
14 Martin Krecker[7]
15 Karl Urban Melcher
16 Juergen Artur Ziegler[8]
17 Horst Paul Schnaase[9]
18 Waldemar von Maydell
19 Schulze (fnu)
20 Heinrich Matthias Eulen
21 Eduard Schmitz
22 Walter Hartz
23 Gustav Karl Fliegner
24 Kurt Panten
25 Helmut Hepp[9a]
26 Dorothea Thiessen
27 Margarete Susu Devrient
28 Dr. Ernst Emil Rexer
29 Fritz Engelhardt
30 Heinz Rackwitz
31 Dr. Heinz Karl Moehr
32 Dr. Wolfgang Gramberg

50 Aksyanov (fnu)
51 Burdiashvili, Shaley Savovich
52 Lomadze, /Eteri/
53 unidentified
54 Prokudin, Ivan Petrovich
55 Yelkin (fnu)
56 Gorizontov, /Boris Arkadyevich/
57 Toshchev (fnu)
58 Listopad (fnu - husband)
59 Listopada (fnu - wife)
60 Suslenikova, Vera Mikhaylovna
61 Frolova (fnu)
62 Sokolova (fnu)
63 Rudanovskiy (fnu)
64 Oziashchvili, Edika
65 unidentified
66 unidentified
67 unidentified
68 Shamba, Nadezhda Alekseyevna
69 Assotiani, Yasha Rademovich
70 Skiriya (fnu)
71 Fursa (fnu)
72 unidentified
73 Tsomaya (fnu)
74 Kirvalidze (fnu)
75 Mitrenin, Boris Petrovich

[redacted] 25X1

25X1

Functions of Sections

9. Each section of the Thiessen department is identified by a letter from A to I. The various periods shown on the organizational chart are identified by digits from 1 to 5. For example, the code A - 3 refers to Metallurgical Laboratory I during the period 1947/1948 to 1948/1949:

For convenience, the sections and time periods are listed again:

A - Metallurgical Laboratory I

B - Metallurgical Laboratory II

C - Technological Section

D - Design Section

E - Thiessen's Laboratory

F - Physical Laboratory

G - X-Ray Laboratory

H - Chemical Laboratory

I - Workshops

1 - mid-1946

2 - end-1946

3 - 1947/1948 - 1948/1949

4 - 1949 - August 1950

5 - August 1950-1952

Section A-1 :	Preliminary experiments for the manufacture of metal diaphragms.
Section A-2 :	Manufacture of highly dispersed reduction powder and powder mixtures.
Section A-3 :	Manufacture of diaphragms by means of sedimentation.
Section A-4 :) Section A-5 :)	Continued development of diaphragms.

25X1

Section B-1:	Non-existent.
Section B-2:	Manufacture of nickel carbonyl powder.
Section B-3:	Non-existent.
Section B-4:	Non-existent.
Section B-5:	Continued development and automation of diaphragms.
Section C-1:	Non-existent.
Section C-2:	Non-existent.
Section C-3:	Manufacture, development, and automation of the production of Standard Thiessen Barrier.
Section C-4:	Corrosion and passivation studies on barriers.
Section C-5:	Continuation of experiments as in C-4 and determination of reaction speed of uranium hexafluoride and water.
Section D-1: to D-5	Prepared design and technical drawings for apparatuses required by all other sections of the Thiessen department.
Section E-1:) E-2:)	Development of diaphragms by means of press and spray methods.
Section E-3:	Non-existent.
Section E-4:) E-5:)	Supervising other sections.
Section F-1:) to F-5:)	a. Development of measuring apparatus for determining gamma and delta gamma over gamma of diaphragms. b. Development of apparatus for determining properties of metal powders by means of sedimentation. c. Development of high-frequency sintering apparatus for use in manufacture of barriers. d. Development of a separation stage for the determination of separation factor of diaphragms. e. Measurement of the mechanical stability of diaphragms.

Section G-1: to G-5:

a. Experiments for the manufacture of metal diaphragms by means of electrolysis.

b. Designing accessory calculating device (slide-rule) for use with Pechukas and Gage apparatus.

c. Cathode dispersion and X-ray experiments.

Section H-1: to H-3:

a. Inorganic analyses.

b. Manufacture or organic barriers.

c. Development of fluorine generators.

d. Studies concerning H_2O evaporation and other distillation problems.

Section H-4: H-5:

Analytical investigations.

Section I-1: to I-5:

Performed precision machine work for all sections of the Thiessen department.

Mitrenin Department (1952-1955)

10. During fall 1952, Thiessen was transferred from Sinop to Elektrostal. He was accompanied by the following Soviet members of his department: Burdiashvili, Sokolova, and two others [redacted] Thiessen was also accompanied by his German son-in-law Hermann Fritz Florek. At the same time Thiessen left Sinop, Yermin departed from Agudzeri, possibly to the same location as Thiessen. Thiessen took with him from Sinop all equipment and apparatuses which had been used for barrier manufacture. Source listed the following equipment: 25X1

[redacted] 25X1

11. [redacted] 25X1

12. At the time that Thiessen was transferred, Prokudin, a Soviet member of the Thiessen department who from 1950 to 1952 had been carrying out the corrosion experiments [redacted] made preparations to transfer to an institute in Leningrad. [redacted] 25X1 All the corrosion equipment was crated and was sent away; but at the last minute Prokudin was ordered to remain behind in Sinop.

13. Upon the departure of Thiessen, the department was placed under the Soviet Mitrenin. As far as the German specialists were concerned, the date of Thiessen's transfer coincided with the end of classified work. The Soviets had gradually removed the Germans from key projects as early as mid-1950. [redacted] 25X1 Classified work in the most extensive sense of the word, [redacted] ended with the departure of Thiessen in fall 1952. The organization of the department of Mitrenin between fall 1952 and the time of the departure of the German specialists from Sinop in March 1955 was as follows:

Section	Functions	Personnel
Metallurgical I	Development of germanium and silicon monocrystals	28*, 30, 29, 51, 68
Metallurgical II	Manufacture and determination of properties of highly dispersed iron powder particles	5*, 25, 57, 69
Technology	Determination of physical properties of semiconductors developed in the Metallurgical I section	74* and two unidentified persons
Design Office	Design of apparatus required by other sections	75*
Physical Laboratory	Working in cooperation with Metallurgical I, this section made sintering experiments with germanium and silicon powders	4*, 9, 71

X-Ray Laboratory	X-ray studies, electron microscopy, and surface treatment of copper (electrolytic)	3*, 61, 72, 27, 7, 73, 64, 65
Chemical Laboratory	Analytical studies connected with distillation problems	2*, 54, 55, 62
Workshop	Prepared precision machine work for the entire department	8

Notes on Soviet Personnel

14. [redacted] Soviet personnel connected with the Thiessen department [redacted] 25X1

Aksyanov (fnu) /possibly should be Aksyantsov/

Assigned to Metallurgical Laboratory of Thiessen Department; responsible for manufacture of sintering material. [redacted] 25X1

Assotiani, Yasha Rademovich

Georgian. [redacted]

Burdiashvili, Shaley Savovich

Senior Scientific Associate. [redacted] 25X1

Frolova (fnu), Mrs.

Assigned to the fluorine analysis project in the chemical laboratory of the Thiessen department.

Gorizontov, /Boris Arkadyevich/

[redacted] 25X1

Kirvalidze (fnu)

Kandidat nauk [redacted] 25X1
he was in Sinop as Senior Scientific Associate in Mitrenin's laboratory [redacted]

Listopad (fnu), Mr. and Mrs.

[redacted] 25X1
Mr. Listopad was assigned to Prokudin's /q.v./ laboratory, while Mrs. Listopada worked [redacted] on the project for the improvement of tubular barriers by direct decomposition of nickel carbonyl. [redacted] 25X1

Lomadze, /Eteri/

Junior Scientific Associate. Assigned to chemical laboratory of the Thiessen department [redacted] 25X1

Mitrenin, Boris Petrovich

In 1952, he took Thiessen's post in Sinop. [redacted] 25X1

Oziashvili, Edika [redacted]

Worked on electron microscopy and X-ray in the Thiessen department. [redacted] 25X1

Prokudin, Ivan Petrovich

[redacted] 25X1

Rudanovskiy (fnu)

Deputy department chief in Zavod 12, Elektrostal. [redacted] 25X1

Shamba, Nadezhda Alekseyevna [redacted] 25X1

At first was assistant to Burdiashvili, and later to Dr. Rexer. [redacted]

Skiriya (fnu)

Wife of Assotiani /q.v./. Worked on analytical chemistry problems in the Thiessen department's chemistry laboratory.

Sokolova (fnu), Mrs.

Headed the chemical laboratory of the Thiessen department. [redacted] 25X1

Suslenikova, Vera Mikhaylovna

In Sinop until 1951. [redacted] 25X1

Toshchev (fnu)

[redacted] Served as a laboratory assistant, [redacted] 25X1

Tsomaya (fnu)

Assisted Wittstadt and Franke on electron microscope problems. [redacted] 25X1

Yelkin (fnu)

Either Scientific Associate or Senior Scientific Associate. [redacted] 25X1

PREELIMINARY RESEARCH ON DIFFUSION BARRIERS IN SINOP

15. [redacted] 25X1

16. No concrete technical requirements were announced by Thiessen in respect to the porous material, nor did he specify the type of material that was to be used. [redacted] the leading members of the Thiessen group each chose or were assigned a method for development for which they were best qualified, based on their predilection or past experience: 25X1

a. Siewert: manufacture of organic diaphragms.

b. Wittstadt: manufacture of metal foils by an electrolytic process

c. Thiessen: pressed metal powder diaphragms.

d. Aksyanov (Soviet): manufacture of metal (probably copper) diaphragms.

e. Bartell: development of measuring apparatus to measure the porous materials produced by the separate sections; he first used the pressure-equalization method.

17. It was not until the end of 1946 that the technical requirements in the form of gamma and delta gamma over gamma specifications were made available. These were: gamma (permeability) equal to 0.8 to 1.2×10^{-3} and delta gamma over gamma (change in permeability) less than three percent. The delta gamma over gamma value was specified over a range from 15 to 65 mm of mercury. These requirements did not yet state that the diaphragms had to be metal, but simply specified "stability in respect to uranium hexafluoride." [redacted] this late 1946 definition of barrier properties in terms of gamma and delta gamma over gamma did not have any effect on the preliminary program which had been started in May 1946. 25X1

18. A few weeks later (end 1946 to beginning 1947), however, Lt. Gen. Avraamiy Pavlovich Zavenyagin visited the Thiessen Department in Sinop and ordered that metal diaphragms be given preference over organic diaphragms. That is, they were to continue to make the porous dia-

phragms in the manner Thiessen had made them ever since May 1946. This was not because Thiessen's work was the most advanced in comparison with the other development projects listed above. On the contrary, [redacted] Siewert's organic work had progressed ahead of the sections using metallurgical approaches. In any event, the work on the organic diaphragms would have been seriously handicapped[10] at this time, as Siewert and Thiessen had a personal falling out. 25X1

19. Thiessen in his own laboratory, with his assistants, Miss Kittan (later Mrs. Srocke), Miss Schilling, and /Martin/ Krecker, continued to work on sintered metal-powder diaphragms by means of a pressing method. He used for this purpose a modified German press, not in excess of twenty tons, which had been used during the war to manufacture cartridge cases.

20. The other groups were reorganized. Soon not only Siewert's project but also Aksyanov's project was dropped. Burdiashvili and Ziegler began to manufacture nickel powder by the reduction method. [redacted] Bartell and Wittstadt continued with their old projects, the design and construction of measuring equipment and the development of barrier material by the electrolytic process, respectively. This was the division of the Thiessen department which lasted into 1948. 25X1

21. [redacted] 25X1

22. Thiessen obtained satisfactory diaphragms by means of the pressing process in spring 1947. [redacted] 25X1

--

10. [redacted]

11. [redacted]

12. [redacted]

[redacted] 25X1

23. [redacted]

24. [redacted]

25. [redacted]

STANDARD THIESSEN PRODUCTION BARRIER

General Description

26. At about the time (spring 1947) that the first pressed diaphragms were manufactured with nickel powder obtained from nickel carbonyl, the Thiessen department received additional technical specifications which included the required exterior dimensions for the barrier. [redacted] 25X1 Since these larger dimensions could not be obtained by the pressing method, Thiessen turned to producing barriers by a spraying process. Throughout 1947 and the early part of 1948, countless experiments were made in connection with this development until the optimum regimen was finally determined. It is very likely that sample barriers produced by the spraying method and representing the status of development as of a given time were sent outside Sinop for inspection. [redacted] 25X1 Sometime around 1947/1948, the order came for the production of 300 to 400 barriers by the spraying method. [redacted] 25X1

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13. After the development of the barrier proper in Sinop was completed, the specifications for gamma were raised. [redacted] 25X1

27. Working on a 24 hour a day schedule, the production section of the Thiessen department turned out the 300 to 400 barriers, which constituted a zero or test series. [redacted] 25X1 The barriers were individually wrapped in tissue paper and then placed in wooden boxes, each containing 100 barriers; wooden partitions formed sections holding 10 barriers each. Although throughout all of 1948, experiments were continued in the Thiessen department to improve the sprayed barrier [see pages 28-32], it was the barrier of this test series that was introduced into Zavod 12, Elektrostal, in June 1948. For this reason, it will be referred to in this report as the Standard Thiessen Barrier.

28. While the work to improve the barrier was in progress, occasional orders for additional series of the Standard Thiessen Barrier were received in Sinop. [redacted] between 1948 and 1949, 25X1 at least three or four series of 1,000 barriers each were produced in Sinop. On each occasion, personnel who had meanwhile been assigned to help in other sections of the Thiessen department or had been working on small experimental series in connection with the improvements were conscripted and for a short while worked under great pressure on a 24 hour per day schedule. Again it should be noted that these were series of the Standard Thiessen Barrier as it existed in the beginning of 1948 and as it was introduced in June 1948 in Zavod 12, Elektrostal; these series were not affected by the experiments, then in progress, aimed at improving this barrier.

29. [redacted] these production series were required to overcome critical needs of a cascade because of some mishap. [redacted] the barrier in a cascade could easily be made unserviceable 25X1 by opening a wrong valve, permitting the pressure across the barrier to become too high and causing a collapse of the tube. [redacted] 25X1

Flow Chart and Description of Production Steps

30. A flow chart identifying the thirteen separate steps in the production of the Standard Thiessen Barrier, as they were introduced in Zavod 12, Elektrostal, during the summer of 1948 is given below:

(1) Determination of nickel powder properties
(2) Preparation of the suspension

(3) Cutting of wire screen
(4) Electrolytic etching

(5) Spraying

(6) Rolling Step No. 1

(7) Sintering

(8) Rolling Step No. 2

(9) Cutting of the wire screen

(10) Intermediate measurement

(11) Welding of screen into tube

(12) Weighing of finished barrier tube

(13) Determination of permeability of barrier (gamma and delta gamma over gamma values)

31. Concerning these various production steps [redacted] 25X1

a. Preparation of Wire Screen

The wire screen used for the sprayed barrier in Sinop was supplied by an unidentified factory in East Germany. [redacted] 25X1 Everything pertaining to the wire-screen material was considered a matter of security, and was therefore handled by the pervyy otdel or security department in Sinop. [redacted] 25X1 In connection with occasional shortages of wire-screen material in Sinop, [redacted] 25X1 Col. Mikhail Mikhaylovich Kuznetsov of the Ninth Directorate had once traveled to East Germany in order to expedite shipment. [redacted] 25X1

During the experiments leading to the final Standard Thiessen Barrier, diverse wire screens with anywhere from 5,000 to 20,000 mesh per square centimeter were used. It was found that the 5,000 mesh was too coarse and resulted in the sinter mass falling out, while the 20,000 mesh was considered too expensive. It was finally decided to use 10,000 mesh wire screen. The diameter of this wire was recalled to be about .05 mm with an unknown tolerance. After early experiments at cutting the wire in the direction of the mesh, it was later decided to cut the screen diagonally as this produced greater stability. The screen was cut into rectangular sections, 15 cm x 55 cm, which was sufficient for two finished tubular barriers when the sprayed screen was cut again (step 9) and welded (step 11).

 [redacted] 25X1

The rectangular section, 15 cm x 55 cm, was submerged in a bath of hydrochloric acid and was electrolytically etched so as to roughen the surface of the screen and to reduce its thickness. In arriving at a final specification for the etching phase, two diametrically opposed conditions had to be resolved: on the one hand, it was desirable to etch the wire to make it as thin as possible and, on the other hand, it was necessary to retain the stability of the wire screen. These experiments had been carried out in Wittstadt's laboratory, where two large rectifiers of 50 amperes each were available. [redacted] 25X1

b. Spraying Operation

A suspension of nickel powder in ethyl alcohol was sprayed upon the etched and dried rectangular screen. The nickel powder used in the suspension was classified in terms of its shaking weight and shaking volume, and later a particle size which characterized the nickel powder was determined by the Pechukas and Gage test method. [redacted] 25X1

c. Rolling, Sintering, and Welding Operations

After the suspension had been deposited on the etched wire screen, a few rolling passes were executed. The rollers used for this purpose were manufactured at Sinop but received their final machining in an unidentified plant in Tbilisi, as Sinop did not have any cylinder grinding machines. The number of passes for each rolling process was specified after experiments which determined how much rolling the mesh could safely stand and how much the volume available for sintered powder was decreased.

After the first rolling step, the screen was sintered, in a sintering oven, in a reducing atmosphere of hydrogen. [redacted] the barrier was sintered for about one-half hour at a temperature of about 350°C. 14/ 25X1

Before the screen was welded, it was subjected to an intermediate measuring test. For this purpose a Gamma Zange or gamma forceps was designed, with which it was possible to make quick spot checks of the screen and determine whether the barrier had been damaged in production, i.e., large holes formed, etc.

The rectangular screen was then cut into two equal parts which were welded into tubes. The cutting was performed with a simple cutter similar to a photo laboratory paper-cutter. As stated above, the initial requirements were simply in terms of external dimensions for a flat-plate barrier. Sometime in 1947, the Thiessen department was ordered, [redacted], to produce tubular instead of flat-plate barriers. 15/ 25X1

After attempts to solder the nickel wire screen were unsuccessful, it was decided to weld the screen. For this purpose, an electric welding apparatus was designed with which the flat plates, produced in the manner described above, could be welded into tubes. [redacted] the decision to weld the flat plates was an internal one at Sinop, and that the Soviet order had simply called for tubes. The finished tube had a length of 500 mm and a diameter of 15 mm. 25X1

- - - - - - - - - - - - - -

[redacted] 25X1

d. End Pieces of Barrier

[redacted] it appears that the Standard Thiessen Barrier production process which was introduced into Elektrostal had no provision for mounting the barrier. [redacted] 25X1

25X1

e. Measuring Operation

When the Thiessen department first began to work on the development of porous material, Bartell and von Maydell began to design an apparatus with which to test permeability of this material. At first, an apparatus was constructed which made use of a pressure-equalization method. This apparatus, however, did not supply accurate data. In particular, the determination of the time element was inaccurate. In the beginning of 1947, at a time when Thiessen was still making diaphragms by the pressing process, the Soviets supplied a Flaechenmess-apparat (flat-plate measuring apparatus) to Sinop and probably also to Agudzeri. [redacted] 25X1

[redacted] The principal reason for supplying the measuring apparatus was to make sure that the same measurement criteria were used in Sinop as were used in other Soviet institutes. 16/ [redacted] 25X1

The Soviet-made flat-plate measuring apparatus was accompanied by approximately ten etalon diaphragms. These were standard or calibration diaphragms. The etalon diaphragms were made of nickel without wire-screen support, and had exterior dimensions of 10 cm x 15 cm which was approximately the size of the measuring apparatus. An etalon diaphragm had a greater thickness than the pressed diaphragms then made by Thiessen and was extremely brittle. [redacted] 25X1

- - - - - - - - - - - - -

[redacted] 25X1

[redacted] 25X1

The Soviet measuring apparatus was used to measure the rectangular screens after the second rolling operation (step 8). Later, when the order for tubular barriers was issued, the Bartell section built another test apparatus making use of the same principles as the Soviet machine.

32. Concerning the permeability requirements of the barriers, it was already stated /see page 15/ that the specifications were issued only towards the end of 1946. [redacted]

33. [redacted] 25X1

34. The barriers produced in Sinop, at the end of 1947 or the beginning of 1948 satisfied the Soviet technical requirements. The rejection rate was negligible. The reason for this was that in the production series in Sinop each barrier could be treated individually, which was, of course, not the case when the barrier was produced on an industrial scale. Later, when the production process was transferred from the Sinop research institute to the Soviet barrier plant in Zavod 12, Elektrostal, the problem of rejects became significant /see pages 44-50/. [redacted] 25X1
[redacted] practically all the rejects in the Soviet production plant were the result of excessively high delta gamma over gamma values rather than gamma values.

35. [redacted] 25X1

STATISTICAL SURVEY TO DETERMINE OPTIMUM PRODUCTION REGIMEN

36. Sometime in 1948, [redacted] a statistical survey of the Thiessen barrier production regimen. [redacted] to source. The [redacted] aim of the study was to determine the optimum regimen for obtaining barriers with specified gamma and delta gamma over gamma values for use in mass production. It was a rather crude analysis of data and not a real statistical analysis in the orthodox mathematical sense of the term. 25X1 25X1

37. For every barrier that was produced in Sinop during this time, including the production series as well as those barriers produced in connection with studies for improvement of the barrier, a record was made. This information was [redacted] prepared on cards [redacted] The data included: 25X1

a. A number identifying the barrier

b. Powder used:

(1) Nickel carbonyl, reduction, or Monel powder.

(2) Particle size of powder as determined by the Pechukas and Gage method.

c. Quantity of powder per square centimeter sprayed on screen.

d. Number of mesh per square centimeter of screen

e. Etching treatment

f. Number of passes during first rolling step

g. Temperature and time of sintering

h. Number of passes during second rolling step

i. Thickness of finished barrier

j. Weight of finished barrier

k. Gamma and delta gamma over gamma values

38. The information on the cards was plotted graphically in a great number of ways. These graphs may be divided logically into two series. The first series of graphs showed how the thickness, final weight, and gamma and delta gamma-gamma values varied for changes in parts of the production regimen. The second series, which was produced after study of the first, showed the optimum regimen to be used for the production of barriers which would meet the technical specifications for a given powder quality. [redacted] 25X1 this second series of curves was developed for the use of relatively unskilled technicians; it was to be used in the factory to determine the parameters for the production of the Standard Thiessen Barrier.

39. [redacted] 25X1

40. In graph 1 on page 26, the particle size of the powder as measured by the Pechukas and Gage method is plotted against the optimum weight of powder per unit area which should be sprayed on the screen as the first step in the process to produce the Thiessen nickel-wire mesh barrier which would meet the specifications. [redacted] 25X1 a second curve could be plotted on the same graph for use with nickel powder manufactured by the reduction method.

41. The number of passes to be specified for the first rolling process was determined from Graph 2 on page 26. The values on the ordinate of this graph are identical with those on the abscissa of Graph 1.

42. The temperature at which the sintering oven should be set for the specified sintering time (one-half hour) was then determined from Graph 3.

43. The number of passes required in the second rolling is given in Graph 4 on page 26.

44. Similar graphs determined the current to be used in the etching process and the nozzle diameter and powder-to-alcohol ratio in the spraying process.

45. Over 90 percent of the barriers manufactured according to these directions lay within the specified values for gamma and delta gamma over gamma. For a specified range of gamma from 1.0 to 1.4×10^{-3}, the target value would be 1.2×10^{-3}.1/ In this case, over

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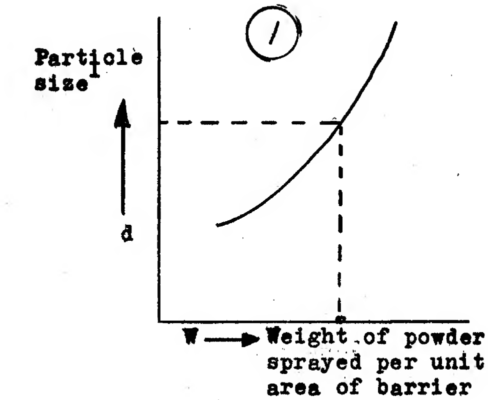
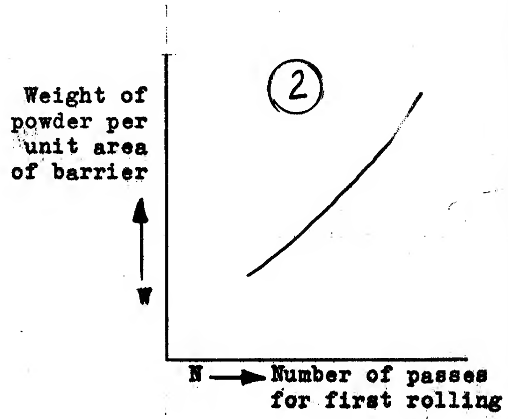
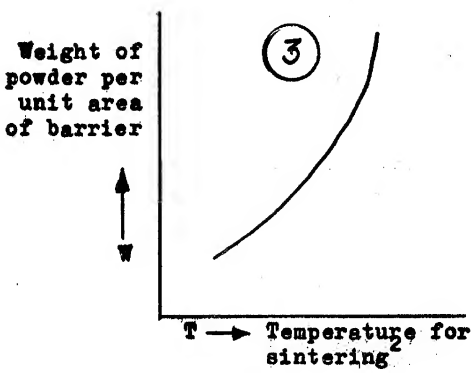
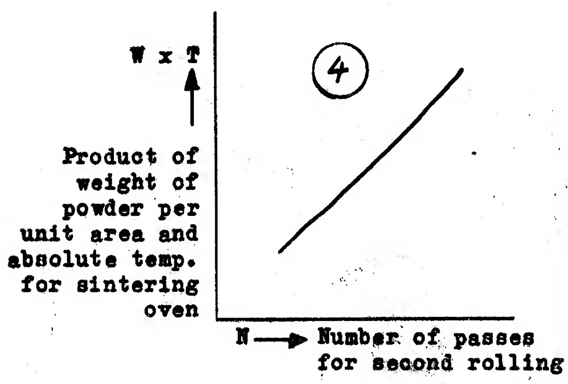
[redacted] 25X1

 25X1









1. Particle size as measured by the Pechukas and Gage method.

2. The time of sintering was fixed at about one-half hour.

75 percent of the tubes would have gamma values between 1.1 and 1.3×10^{-3}, approximately 12 percent between 1.3 and 1.4×10^{-3}.

46. [redacted] 25X1 It is evident that lower delta gamma over gamma values are associated with lower gamma values. [redacted] that with very strict 25X1 control of the process it would be possible to manufacture the Standard Thiessen Barrier with a delta gamma over gamma of two percent over a range of gamma from 1.0 to 1.4×10^{-4}, if a rejection rate of about 50 percent could be accepted. [redacted] 25X1 a lower delta gamma over gamma specification for tubes with an average gamma of 1.2×10^{-3} would be out of the question. None of the Standard Thiessen Barriers with gamma values of 1.0×10^{-3} or larger had a delta gamma over gamma of less than one percent.

EXPERIMENTS TO IMPROVE BARRIER QUALITY

47. The Standard Thiessen Barrier had been successfully completed and the zero series approved by the beginning of 1948. During summer 1948, the manufacturing process for the Standard Thiessen Barrier was introduced into Zavod 12, Elektrostal, by a German group [redacted] 25X1

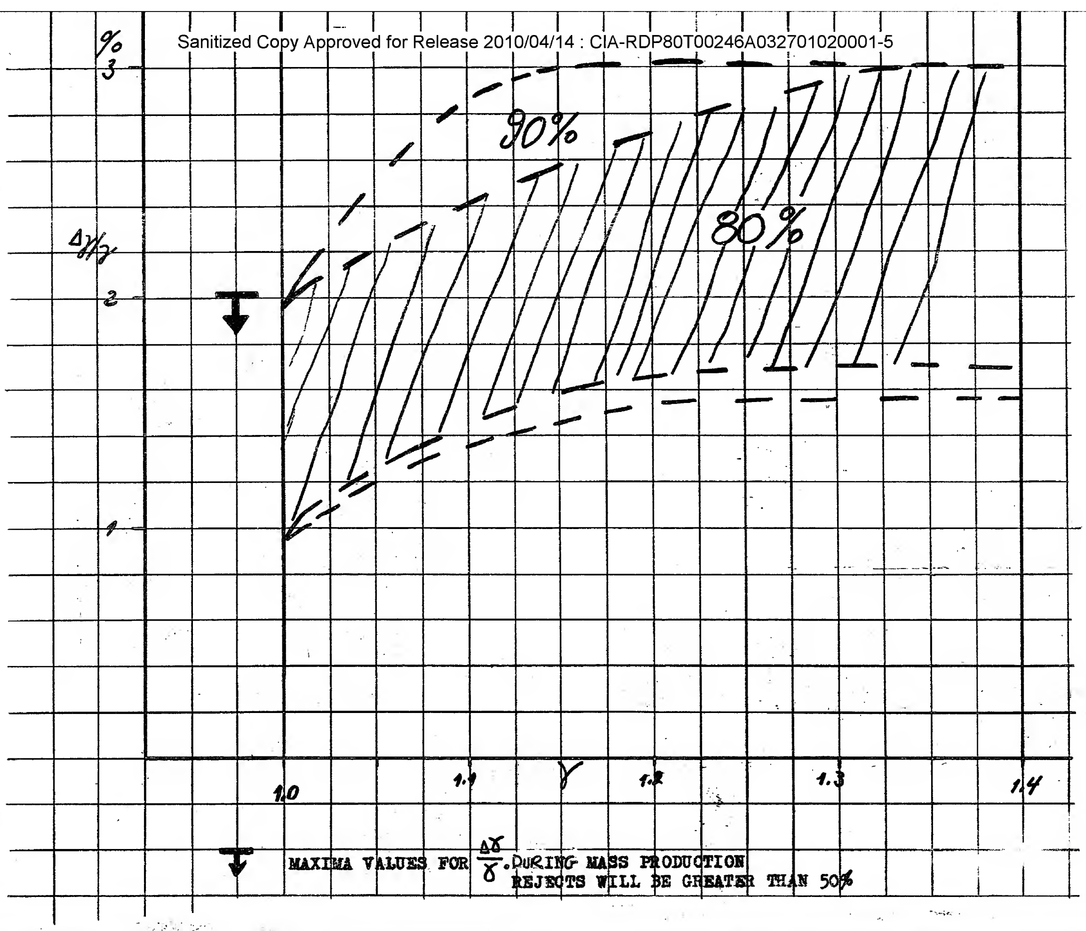
48. Also during 1948 and 1949, the Thiessen department received orders for three or four series of the Standard Thiessen Barrier of 1,000 barriers each [see page 18].

49. In addition to these production efforts, the Thiessen department, in 1948 and 1949, was engaged in work aimed at modifying or improving the Standard Thiessen Barrier. [redacted] 25X1

50. Most of the improvement work was a natural outgrowth of the barrier work that had been performed up to this time in Sinop, and the initiative was distinctly local. Within the framework of the Standard Thiessen Barrier project, it was hoped to simplify the technological production steps and also to improve the inherent characteristics of the barrier, such as the mechanical stability or the separation factor.

51. Some of the development tasks of this period were of a different nature. That is, the initiative came from outside Sinop. [redacted] 25X1

ESTIMATE OF DELTA GAMMA OVER GAMMA DISTRIBUTION IN PRODUCTION OF THIESSEN TUBULAR BARRIERS.



25X1

52. The barrier development tasks of this period are, therefore, listed under two categories:

a. Experiments to Improve Standard Thiessen Barrier. The experiments or manipulations which aimed to improve the Standard Thiessen Barrier or its production process included the following:

(1) Variations of Rolling and Spraying Steps. Experiments were conducted in which the spraying and rolling processes were varied in order to determine the effect on barrier quality. These experiments included: spraying one side of the barrier only, leaving the other side of the screen bare; spraying a thin layer of powder on both sides of the screen; covering the screen with powder and then immediately sintering the mesh instead of first subjecting it to rolling.

(2) Butterbrot. Experiments were conducted in which a layer of coarse powder was sprayed on a wire screen, and over this a second layer of fine powder was sprayed. This development task was carried out by Krecker and Miss Schilling in the personal laboratory of Thiessen and went under the nickname (not an official code word) of Butterbrot. In some experiments, the first layer was sintered and rolled before the second layer was applied. [redacted] 25X1 The coarse powder was selected by the Pechukas and Gage method. In addition to using nickel carbonyl powder, obtained by altering the production regimen, reduction powder obtained locally and powder delivered from outside Sinop were used for the coarse powder layer. Measurements of the gamma and delta gamma over gamma value of the coarse layer were made with the Gamma Zange (gamma forceps). [redacted] 25X1 For the fine layer, the standard nickel carbonyl powder used in Sinop for the

- - - - - - - - - - - - -

[redacted] 25X1

Standard Thiessen Barrier was always used.[19] [redacted]

25X1

(3) Fahrstuhl. Two machines for treating barriers, making use of radio-frequency heating for sintering the barrier, were developed by Bartell and von Maydell. These machines were referred to as Fahrstühle (elevators), because the heating coil was moved swiftly over the vertically mounted barrier. [redacted] At high temperatures, there is a strong tendency for two small particles to coalesce to form one big particle which, of course, is disadvantageous for a diffusion barrier.

25X1

[redacted]

25X1

- - - - - - - - - - - -

[redacted]

25X1

(4) Monel Powder. Ziegler developed a method to produce Monel powder by reduction. After Ziegler left Sinop in 1948, the experiments were continued by the Soviet Burdiashvili. [redacted] Monel was considered as an alternate to nickel because this copper-nickel alloy is cheaper than nickel. [redacted] 25X1 25X1

b. Variations of the Standard Thiessen Barrier

(1) Conic Barriers. The Thiessen department developed, presumably on the request of an unidentified installation outside Sinop, a sprayed barrier of conical shape. As the Thiessen department used the Standard Thiessen Barrier spraying process in this development, the task was simply and quickly accomplished. It was required only to design and construct larger welding machines. A small series of these conic barriers [redacted], was produced in Sinop and sent to an unidentified installation. These barriers were not investigated for separation factor, as suitable separation stages were not available in either Sinop or Agudzeri. [redacted] 25X1 25X1

(2) Odd-Sized Barriers. Another task which, for reasons similar to those given for the conic barrier, must have originated outside Sinop called for the manufacture of two series of tubular barriers having odd-sized diameters between 30 and 35 mm and between 20 and 25 mm. In each case, a small series was manufactured and sent to an unidentified installation.

(3) Duplex Barrier. Still another barrier development task, which evidently was for an installation other than Sinop, called for the design of a duplex barrier. That is, two tubes were mounted concentrically. The inside tube had a diameter of 13 mm while the outside tube had a diameter of 15 mm. Again, a small series was produced which went to an unidentified installation.

c. Separation Tests of Modified Barriers. The above list is not exhaustive. Anywhere from 20 to 50 barriers were made as result of each of these experiments. These barriers were shipped away from Sinop, [redacted] None of these experiments led to any major improvement of the Standard Thiessen Barrier, and [redacted] none of the variations (sub paragraph a) had been incorporated into the Soviet production program of the Standard Thiessen Barrier [redacted] Samples of the barriers, especially those listed under paragraph a, were sent to Bartell's laboratory, where a separation stage and equipment to measure the mechanical stability of the barriers was available. These improvements gave no changes in the gamma and delta gamma over gamma values as compared with the normal production series (i.e., Standard Thiessen Barrier) in Sinop. [redacted] In connection with Bartell's work, [redacted] the separation experiments were made with a mixture of carbon tetrachloride and benzol, and that the separation factor was determined by means of "zero density determination." That is, the density for two model gases taken separately was first determined. The gases were then condensed and mixed. Thereupon, the density of the mixture was measured. It was then possible to calculate the difference in density between the diffused and non-diffused gas.

AUTOMATION OF PRODUCTION PROCESS FOR STANDARD THIESSEN BARRIER

53. [redacted]

20.

[redacted] 25X1

54. While source had no detailed information, he was sure that the Soviet Rudanovskiy worked on automation in Sinop from August 1950 to fall 1951. [redacted] Rudanovskiy had been deputy director of the tsekh in which the Thiessen barrier was being introduced. [redacted] When Rudanovskiy arrived in Sinop in August 1950, [redacted] his transfer had involved a demotion resulting from a scandal of some kind, [redacted] Rudanovskiy was accompanied by an unidentified Soviet who was related to him by marriage. At this time, a special section was organized in the Thiessen department and was headed by the Soviet Prokudin; it was staffed only with Soviets.[21] The major preoccupation of this section was corrosion and passivation work. Rudanovskiy took charge of a subsection in the Prokudin section, and with a staff of approximately six other Soviets, including the aforementioned relative, worked on the problem of automatizing the production process for the manufacture of the Standard Thiessen Barrier. [redacted] Rudanovskiy might have coupled this work with attempts to improve the Standard Thiessen Barrier. 25X1 25X1 25X1 25X1

55. [redacted] the laboratory was out of bounds to all Germans except Thiessen. [redacted] an assembly line with a large number of rollers and rolling tables had been set up. To satisfy the space requirements for such an assembly line system, Rudanovskiy had been given a room at least 15 meters long in the basement of the Thiessen department's building in Sinop. 25X1

56. [redacted] 25X1

21. [redacted]

22. [redacted]

[redacted] 25X1

57. [redacted]

58. The work of Rudanovskiy and his subsection continued until the middle or end of 1951, at which time Rudanovskiy and his relative left Sinop abruptly for an unidentified destination. Rudanovskiy's transfer was again accompanied by a scandal.[23/]

COMPETING TYPES OF BARRIERS DEVELOPED AT SINOP

59. The Standard Thiessen Barrier was not the only barrier designed or developed in Sinop between 1945 and 1955. Upon the crystallization of the Soviet specifications, the spraying technique of Thiessen became the nucleus of the development work, and evidently this technique was accepted by the Soviets as a solution for the barrier project when it was introduced into Elektrostal.

60. Once the barrier technique of Thiessen was accepted for production, however, at least two efforts were made at Sinop to develop different methods for manufacturing barriers. The aim was "simplifying, or rather reducing the number of manipulations; basic changes were made with the aim of getting away from inaccurate manual work by using machine operation." Neither of these efforts appears to have had at any time a priority (in terms of manpower or material) assigned by the Soviet administration in Sinop, and they can fairly accurately be described as the independent efforts of the Soviet Burdiashvili [redacted] 25X1

Ziehl's Barrier Development - Direct Decomposition Method

61. [redacted] 25X1

62. [redacted]

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23. On Rudanovskiy's order, a Soviet laboratory assistant had attempted to desiccate in a vacuum drying oven a fairly large quantity of an unidentified explosive material. Soon after the material was placed in the oven and the bolts were secured, an explosion occurred which destroyed the vacuum oven and fatally injured a Soviet workman. An official investigation established Rudanovskiy's responsibility.

[redacted] 25X1

63. [redacted] were as follows:

a. Direct Deposition of Nickel Powder on Single Tubes. [redacted] 25X1 A screen was welded into a tube of required dimensions, and this tube was processed into a barrier as follows:

(1) The sketch on page 36 shows the equipment for the first steps of the process: In a vertically mounted cylinder (not shown) was placed the tube that had been welded from wire screen (Point 2). Within the screen was placed a glass tube (Point 1), and within the glass tube was located a heating coil (Point 3). The entire assembly could be rotated. The glass tube and the wire-screen tube were concentric, with a slight gap between the two walls. Into this gap was fed a mixture of nickel carbonyl and nitrogen (Point 4). The nickel carbonyl then decomposed directly inside and along the meshes of the heated wire screen to form nickel powder (Point 5) and carbon dioxide.

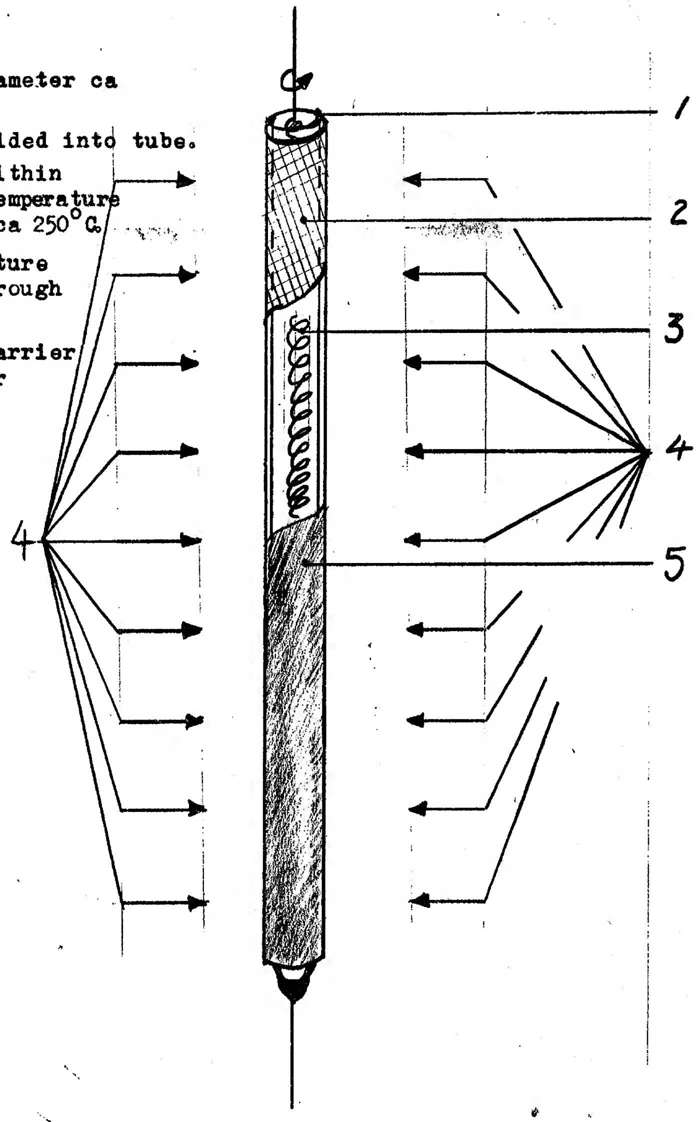
(2) In order to assure a uniform distribution of nickel powder along the screen, a pair of ventilators was placed in the gap between the glass tube and the screen tube to act as stirrers. The ventilators are not shown on the sketch.

(3) For the second step of the process, a planetary roller system was designed. Figure 1 on page 37 is a perspective view of the machinery when in operation. Figure 2 on page 37 shows the machinery when opened. The points described below refer to Figure 2 on page 37.

(4) Point 1 is a pressure roller which locks the tubular barrier (Point 3) in the roller frame (Point 2), which consists of two rollers rotating in opposite directions. Within the barrier tube was placed a solid metal rod, of slightly smaller diameter, called Walzkern, (Point 4). In order to take into account the expansion and the deformation of the barrier tube, a number of these Walzkerne were available, each differing in radius by

/Text continued on page 38/

1. Glass tube, diameter ca 10-12 mm.
2. Wire screen welded into tube.
3. Heating coil within glass tube. Temperature of glass wall ca 250°C.
4. $Ni(CO)_4$-N_2 mixture enters here through jets.
5. Wire screen (barrier material) after experiment.



APPARATUS FOR MANUFACTURE OF TUBULAR BARRIERS BY DIRECT DECOMPOSITION OF $Ni(CO)_4$-N_2 MIXTURE ON WIRE SCREEN TUBE

Planetary Roller System
Fig. 1 Opened
Fig. 2 Closed

1. Pressure roller.
2. Roller table.
3. Diaphragm on Walzkern.
4. Walzkern (different diameters available).

S-E-C-R-E-T

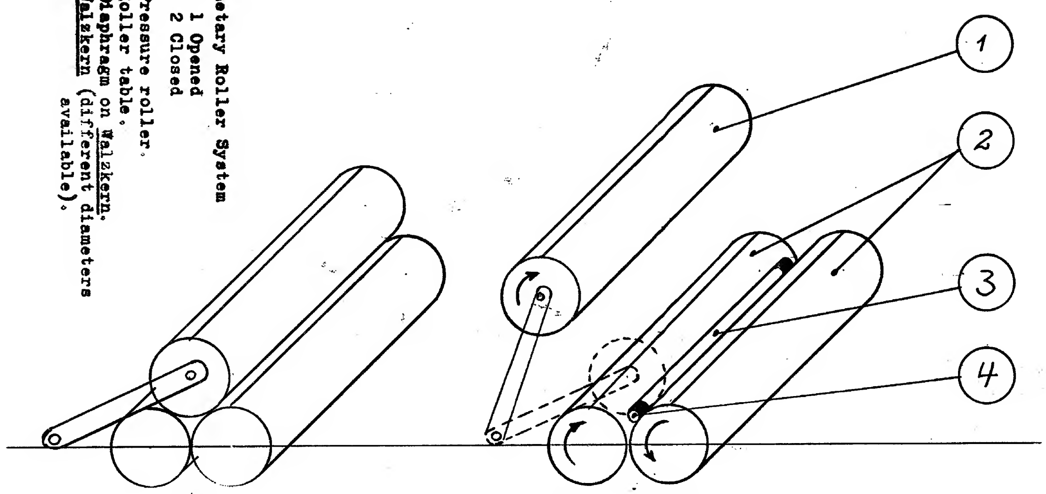


Figure 1   Figure 2

25X1

PLANETARY-TYPE ROLLERS USED IN CONNECTION WITH APPARATUS FOR THE MANUFACTURE OF TUBULAR BARRIERS BY DIRECT DECOMPOSTION OF $Ni(CO)_4$-N_2 MIXTURE ON WIRE SCREEN TUBE

0.1 mm. After a few passes, the Walzkern was withdrawn from the barrier tube, and the next appropriately dimensioned Walzkern was inserted into the tube.

(5) [redacted] this system could not work, as it was impossible to take account of the various deformations of the barrier tube. Because of the counterrotation of the two base rollers between which the Walzkern rested, the barrier tube always formed bulges which were then rolled flat. Consequently, the barrier always developed creases or was torn. 25X1

(6) [redacted] 25X1

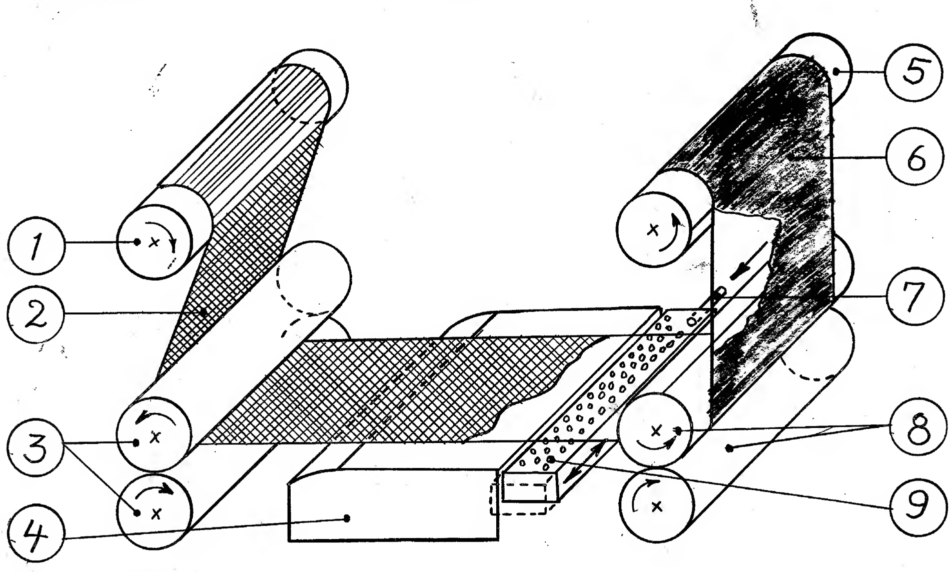
(7) This process did not provide for sintering. It was found that the direct decomposition would link the nickel particles sufficiently without sintering. The screen was heated and, as the first particles decomposed along the wire screen, each particle became heated and thus permitted another nickel particle to decompose on top of it. When these were rolled, the cohesive strength was believed to be sufficient.

(8) In addition to making sintering unnecessary, this system was thought to have another advantage in that it would yield a more favorable structure than was obtained with Thiessen's spraying method. [redacted] it, the nickel particles have a tendency, both in the generator and during the spraying process, to coagulate in a form similar to cotton batting, that is, they form a loose structure of indefinable shape. In the direct decomposition of nickel carbonyl, however, the cotton batting phenomenon hardly ever occurred, and if it did, the interconnected crystals were rolled into the meshes of the screen. 25X1

(9) The above experiments proved the feasibility of the principle of direct decomposition, even though it demonstrated the impracticability of the planetary roller system. This equipment was, therefore, discarded and was soon forgotten. The direct decomposition principle, however, was then transferred to equipment which could fabricate barriers continuously in the form of a running strip.

b. Running-Strip Process for Direct Deposition. [redacted] making use of a running-strip system, was nicknamed locally "Pandora's Box." A perspective drawing of the system appears on page 39. 25X1

1. Roller with untreated wire screen [illegible] clutch.
2. Wire screen (ca. 25 cm wide)
3. Transport roller
4. Heating table (temp. below 400° C and [illegible]
5. Collector roller for finished barrier materi al
6. Barrier material



SCHEMATIC OF APPARATUS USED IN RUNNING STRIP PROCESS FOR DIRECT DEPOSITION OF $Ni(CO)_4$-N_2 MIXTURE ON WIRE SCREEN.

7. Tube through which the $Ni(CO)_4$-N_2 mixture enters
8. Pressure and transport roller, synchronized with roller (Point 3)
9. Jet device; moves in direction of arrows by a distance equal to distance between jets and with a frequency of less than 50 cycles.

25X1

(1) A strip of wire screen of the same specifications as that used for the Standard Thiessen Barrier was "etched" and then was wound onto a run-off spool (Point 1). This run-off spool was equipped with a slipping clutch. The nickel wire screen (Point 2), which had a width of approximately 20 or 25 cm, was slowly unrolled by the driving rollers (Points 8 and 9). The speeds of all rollers were synchronized. While passing between the rollers (Point 3) and rollers (Points 8 and 9), the wire screen passed over a heated plate (Point 4), which was kept at a temperature which was above 200° C and below 400° C. After passing over the heating plate, the wire screen passed over an arrangement of jets (Point 9), from which fine streams of nickel carbonyl and nitrogen emerged. There were at least 20 jets. The distance between the jets of the same row was roughly 10 mm. The jet device moved in the direction indicated on the sketch and with an amplitude equal to the interval between the jets. There may also have been an added elliptical movement. The frequency of the oscillation was below 50 cycles per second. [redacted] The purpose of the movement was to obtain uniformity of the sprayed layer. [redacted] The jets in the spraying device were externally cooled with water.

25X1

25X1

(2) The wire screen (Point 6), on which the nickel powder had been deposited by decomposition of the nickel carbonyl, then passed through the rollers (Point 8 and 9) and was wound on the collector roller (Point 5).

(3) If a sufficient quantity of nickel powder was not deposited on the first run through the apparatus, it was possible to send the roll of wire screen once again through the entire process.

(4) [redacted] The wire screen moved at a speed of about one millimeter per second over the jet device, or about three meters per hour.

25X1

(5) The process did not provide for a sintering step. This was not thought to be required, but such a step could easily be added to the process without loss to the automatic character of the machinery. [redacted]

25X1

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[redacted]

25X1

(6) [redacted] 25X1

In some respects, the mechanical properties of this barrier material were superior to those of the Standard Thiessen Barrier. This was especially true of its ductility. The powder clung so hard to the wire screen that it would not fall off when the wire was vigorously bent back and forth, whereas with the Standard Thiessen Barrier such a procedure would leave a bare wire screen. [redacted] 25X1

(7) [redacted] this development was very promising, although no tubes had as yet been welded. Suddenly, the entire project was halted, with the explanation that wire-screen material was in short supply. In spite of reports on this project, [redacted] 25X1 the Soviets never evinced interest in the project. Thiessen's role was somewhat more ambiguous. 25/ [redacted] 25X1

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[redacted]

[redacted] 25X1

Burdiashvili's Barrier Development - Sedimentation Method

64. [redacted] Burdiashvili, [redacted] attempted to design barriers using the sedimentation method. [redacted] Burdiashvili came to the sedimentation process simply in an effort to find a method to replace the spraying of nickel powder suspension, which was a disagreeable and unhealthy procedure. 25X1 25X1

65. [redacted] Wire screens which had been etched and rolled were placed at the bottom of a rectangular copper vessel, approximately 60 cm x 60 cm x 12 cm. The wire screen was then covered to a depth of 10 cm with a suspension of methyl alcohol and nickel powder. The nickel powder settled on the wire screen through gravitational pull. The vessel was then slowly drained of the methyl alcohol by means of an outlet provided on the bottom of the vessel. The operation lasted about one hour. After the one-hour sedimentation process, the wire screen bore a more or less uniform layer of nickel powder. The screen was then dried, rolled, sintered, and measured for its permeability characteristics. [redacted] 25X1 25X1

66. [redacted] ethyl alcohol could have been used instead of the methyl alcohol, and that it would have the advantage of being less poisonous; but for reasons of economy, Burdiashvili chose methyl alcohol. The nickel powder used in this sedimentation process was obtained by the reduction method. This is not because the technique required the use of reduction powder instead of nickel powder from nickel carbonyl, but rather because nickel powder from nickel carbonyl was generally in short supply. All the powder produced from nickel carbonyl at that time was required for the spraying method. [redacted] 25X1

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26. In 1946 and 1947, [redacted] Burdiashvili worked on the production of nickel powder by a reduction [redacted] 25X1

67. [redacted] 25X1 Like the Butterbrot barrier, sedimentation entails first a coarse powder layer on which a fine-grained powder layer is deposited. But [redacted] less defined in the sedimentation process (a) because of the very thin coating and (b) because of the elementary magnetism of the nickel powder. Though this elementary magnetism is very small for nickel powder, it nevertheless causes the larger particles to carry along the small particles, so that the medium sized particles settle on the entire surface area. [redacted] 25X1

68. A few hundred barriers of this type were made. Burdiashvili had as many as 50 of the rectangular copper vessels in operation. It was found that the barriers were superior to the Thiessen sprayed barrier in respect to uniformity. [redacted] the disadvantage of the Burdiashvili process was that the barrier was covered with nickel powder on only one side. This led to a lower stability of the barrier tube. [redacted] 25X1

69. The Burdiashvili barrier fully satisfied the technical requirements of the Soviets in respect to gamma and delta gamma over gamma. In fact, their delta gamma over gamma was better by about 0.5 percent, that is, 2.5 percent instead of three percent for the Standard Thiessen Barrier. The gamma value was around 1.0×10^{-3}. 27/

- - - - - - - - - - - - -

[redacted] 25X1

70. In the midst of the development work, [redacted] that the screen material was not available, the experiments were halted. Thiessen had shown very little interest in this work, although the top Soviet administrative official in Sinop, Gen. Kochlavashvili, was supposed to have been interested. [redacted] Thiessen might have feared the competition of Burdiashvili and perhaps disparaged the work for not wholly disinterested motives. [redacted] In 1951, Burdiashvili was honored with a collective Stalin Prize, First Class. [redacted] Thiessen, as well as two Soviets Trubnikov (fnu) and Olshevskiy (fnu), probably from Elektrostal, were also included in this collective Stalin Prize. [redacted] 25X1 25X1 25X1 25X1

71. After this project was discontinued, Burdiashvili worked on spraying processes with reduction powder and Monel powder. [redacted] Towards the end of 1952, Burdiashvili left Sinop with Thiessen, and returned again in January 1955. [redacted] 25X1 25X1

PROCESSES FOR SALVAGING PRODUCTION REJECT BARRIERS

72. [redacted] the problem of salvaging reject barriers [redacted] The problem consisted of taking finished production barriers with delta gamma over gamma or gamma values outside the range of the technical requirements and of devising measures which would bring the characteristics of these barriers into the specified range. 25X1

73. [redacted] 25X1

 [redacted] 25X1

[redacted] 25X1

74. The problem involved was twofold:

a. Given tubes with delta gamma over gamma values higher than the specified limit -- to lower these delta gamma over gamma values.

b. Given tubes with gamma values lower than the specified limit -- to raise these gamma values.

<u>Lowering Delta Gamma over Gamma</u>

75. If a factory mass-produced barrier had a delta gamma over gamma reading in excess of three percent, and if this was not caused by one large hole, it was possible to bring the barrier into the range of the specifications by means of the apparatus which appears on page 46. [redacted] 25X1 The apparatus made use of the principle of direct decomposition of nickel carbonyl on the barrier:

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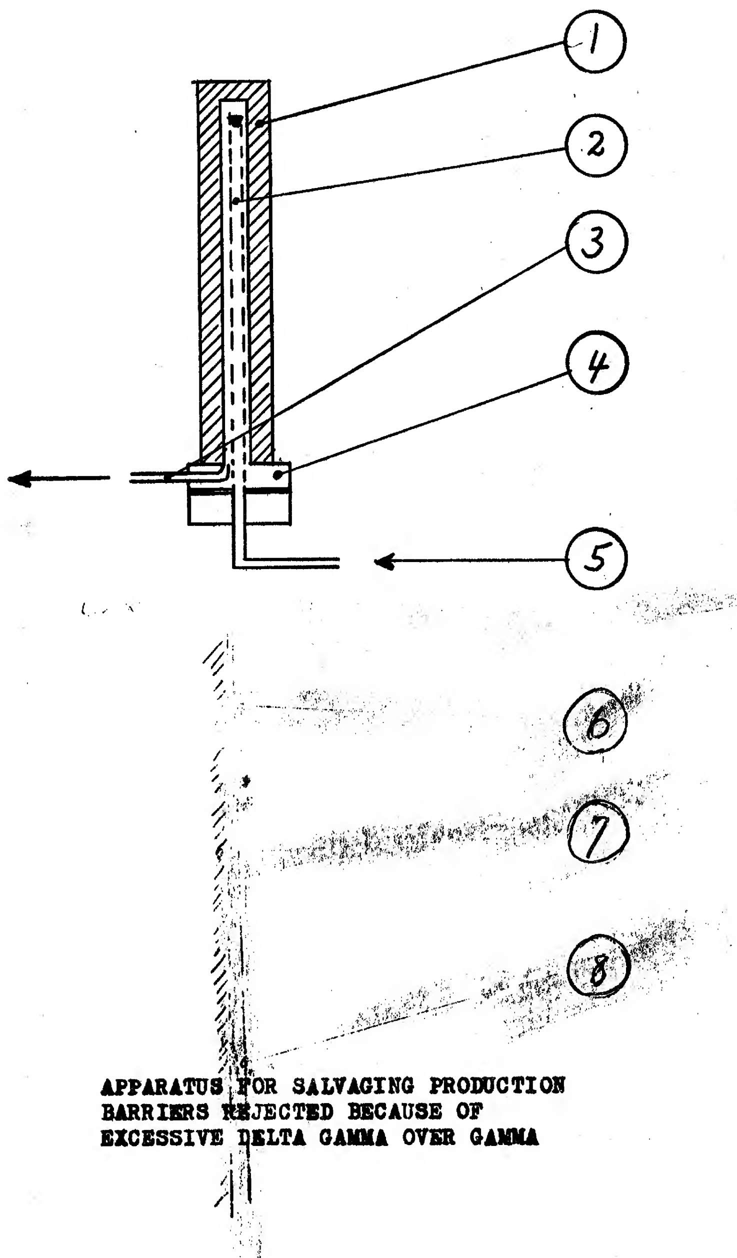
25X1

[redacted]

25X1



APPARATUS FOR SALVAGING PRODUCTION
BARRIERS REJECTED BECAUSE OF
EXCESSIVE DELTA GAMMA OVER GAMMA

a. Point 1 is an electrically heated oven insulated with asbestos, which was kept at a temperature higher than 200°C and lower than 350°C. Into this oven was placed the barrier (Point 2), which was plugged at one end. Point 3 is an exhaust tube, and Point 4 is a cooled flange.

b. A mixture of nickel carbonyl and nitrogen entered the tube (Point 5). The mixture was at a pressure of 30 to 40 mm, and as it passed through the warmed diaphragm, the nickel carbonyl decomposed in the pores of the barrier. The control of pressure was important because of the rapid (quadruple) splitting-off of the CO molecules from the nickel carbonyl. [redacted] no pressures in excess of 50 mm were used. 25X1 Experiments were also made at very low pressures; i.e., 10 mm or 20 mm. [redacted] 25X1

76. The nickel carbonyl decomposed as a wedge-shaped layer with the thicker part at the bottom of the tube. It was, therefore, decided to rotate the barrier by 180 degrees in the middle of the operation. Thus, the end of the barrier which pointed upward during the first half of the operation was pointed downward during the last half of the operation. In this way, a fairly uniform layer of nickel powder was deposited on the surface. [redacted] 25X1

77. As was expected, the larger part of the nickel carbonyl passed through the big pores; the smaller part passed through the smaller pores, thus reducing gamma and improving delta gamma over gamma. [redacted] experiments showed that any barrier could be 25X1 brought into the required norm range if the excess delta gamma over gamma was not caused by a single hole or a few large holes. This treatment of the barrier only very slightly decreased the gamma value.

78. After successful experiments [redacted] constructed another apparatus on the same principle but 25X1 capable of holding five or six or eight tubes at one time. This larger apparatus operated automatically; that is, the valves in the system were electromagnetically actuated and were controlled by an electric programming system. During this operation, a valve placed at the entrance was closed. When a definite pressure was obtained, a magnetic valve opened the entrance for a specified time to let in a specific volume of nickel-carbonyl and nitrogen mixture. This volume was, of course, dependent on the concentration of the mixture. This cycling continued automatically for about one hour. A selector dial on the apparatus made it possible to select in advance the regimen desired; that is, the time the exhaust valve and the inlet valve were to be opened could be programmed.

79. The reason for the lengthy operation was that it was found undesirable to feed nickel carbonyl into the apparatus either continuously or in great quantities at one time. [redacted] 25X1 would lead to a sudden decomposition which would not settle in the pores of the barrier. Therefore, small quantities were sent through at frequent intervals and over a lengthy (one hour) period. This was another reason why low pressures were preferred. [redacted] 25X1 Studies to determine the amount of nickel carbonyl that decomposed on the barrier were carried out [redacted] 25X1 Attempts to determine this quantity by differential weight tests were unsuccessful because of insensitivity of the available apparatus. Finally, the following calculation was used: The initial weight of the nickel carbonyl-nitrogen mixture and its concentration were known. Also the initial pressure was recorded. The difference between initial and final pressure was the pressure that had been applied to the barrier. From this, it was possible to calculate the amount of nickel carbonyl decomposition for the ideal case in which all the nickel was decomposed along the barrier.

80. [redacted] 25X1

81. [redacted]

82. [redacted] 25X1

Increasing the Permeability of the Barrier

83. Increasing barrier permeability was simply a matter of making small pores bigger. The apparatus [redacted] for this purpose was very simple, and no sketch is supplied. The apparatus made use of the following principle: 25X1

a. At a temperature of approximately 60° C, nickel carbonyl was formed from nickel and carbon monoxide. A tube with low gamma values was placed in a glass tube which served

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[redacted] 25X1

as a so-called cooling jacket. The cooling jacket, in turn, was connected with a Hoeppler thermostat, which kept the temperature somewhere between 60° C and 80° C. The heating was not performed with radio frequency but was water heating.

b. At a place of negative pressure, carbon monoxide was introduced, which entered through the pores of the barrier tube. The nickel carbonyl, which was formed as result of the interaction, deposited on the bottom of the device. It was found that more of the gas streamed through the larger holes of the barrier tube, with the result that the larger pores became larger at a faster rate than the small pores of the barrier. This led to a rapid increase in the delta gamma over gamma value, far beyond the permitted specification range, while the gamma value increased relatively slowly.

84. The experiments were carried out shortly before Thiessen's departure from Sinop in late 1952. [redacted] Thiessen included it in the inventory of equipment which accompanied him to Moscow. 25X1

INTRODUCTION OF STANDARD THIESSEN BARRIER INTO SOVIET PRODUCTION

Experimental Tsekh in Zavod 12, Elektrostal

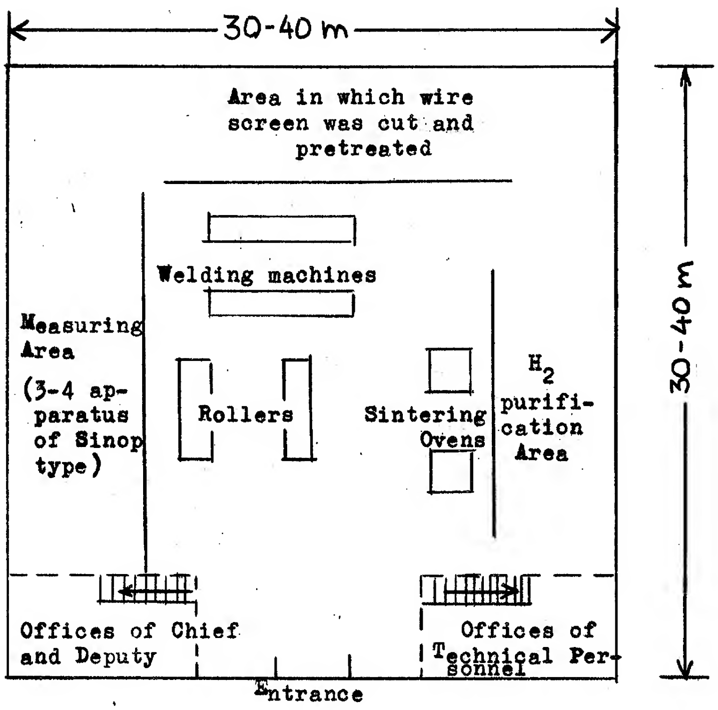
85. In spring 1948, after the first zero series of 300 to 400 Standard Thiessen Barriers had been manufactured in Sinop, [redacted] While there, the group was assigned to the Thiessen department and was instructed in all phases of the production of the Standard Thiessen Barrier. 25X1

86. In the beginning of June 1948, a group of German specialists from the Thiessen department in Sinop was sent to Zavod 12, Elektrostal. [redacted] Until the end of August 1948, they remained in Elektrostal and introduced the process for the manufacture of the Standard Thiessen Barrier.30 25X1

- - - - - - - - - - - -

30. Not all the Germans stayed for the eight weeks. It appears that Thiessen, Krecker, and Miss Schilling left before the end of August. Hartz, too, left earlier for Sinop, but returned again [redacted] 25X1

87. **The Germans performed their work in a small building which served as an experimental plant. The official term for the building was tsekh.** [redacted] 25X1



FLOORPLAN OF EXPERIMENTAL TSEKH, ELEKTROSTAL

88. In the building was exactly the same type of equipment as that used in Sinop for the production of the Standard Thiessen Barrier except that the numbers of every machine or device was multiplied by a factor of four to six. The machinery, with the exception of the sintering ovens, had been built in Sinop. [redacted] 25X1

89. [redacted] 25X1 In front of each building in Zavod 12 was a guard admitting only those who could identify themselves as having access to that particular building. [redacted] 25X1

90. [redacted]

91. [redacted]

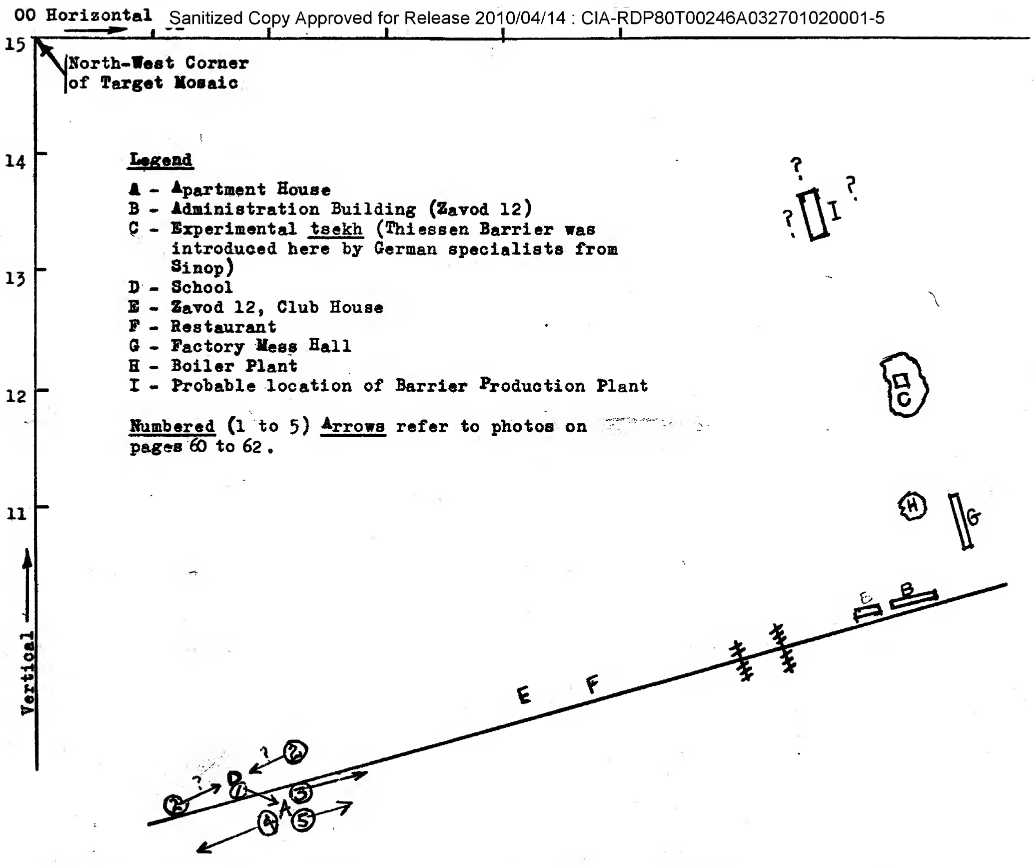
92. [redacted] Galovanov (fnu) was the chief engineer of Zavod 12. [redacted] the experimental <u>tsekh</u> was [redacted] subordinated to the Ninth Directorate of the MVD, and [redacted] the entire Zavod 12 was probably connected with that Directorate. [redacted] prior to beginning work in Elektrostal, the group of Germans from Sinop was briefed by high Soviet officials of the Ninth Directorate in Moscow. These officials included Gen. Zverev and Col. Kuznetsov. [redacted] 25X1

93. [redacted]

31. [redacted]

32. [redacted]

LOCATION OF ZAVOD 12, ELEKTROSTAL



Legend

A - Apartment House
B - Administration Building (Zavod 12)
C - Experimental tsekh (Thiessen Barrier was introduced here by German specialists from Sinop)
D - School
E - Zavod 12, Club House
F - Restaurant
G - Factory Mess Hall
H - Boiler Plant
I - Probable location of Barrier Production Plant

Numbered (1 to 5) Arrows refer to photos on pages 60 to 62.

25X1

25X1

S-E-C-R-E-T

25X1

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S-E-C-R-E-T [redacted] 25X1

[redacted] 25X1

Photo 1: Apartment house or guest house of Zavod 12 in which [redacted] other German specialists from Sinop were housed during their 1948 assignment in Elektrostal. 25X1

Photo 2: A school in Elektrostal. [redacted] 25X1

Photo 3: Ulitsa Karla Marksa. This asphalted street led east from the guest house (1) to Zavod 12.

Photo 4: View west-southwest from guest house (1)

Photo 5: View east from guest house (1).

- - - - - - - - - - - - - - -

[redacted] 25X1

S E C R E T

S-E-C-R-E-T

[redacted] 25X1

1

2

S-E-C-R-E-T

S-E-C-R-E-T

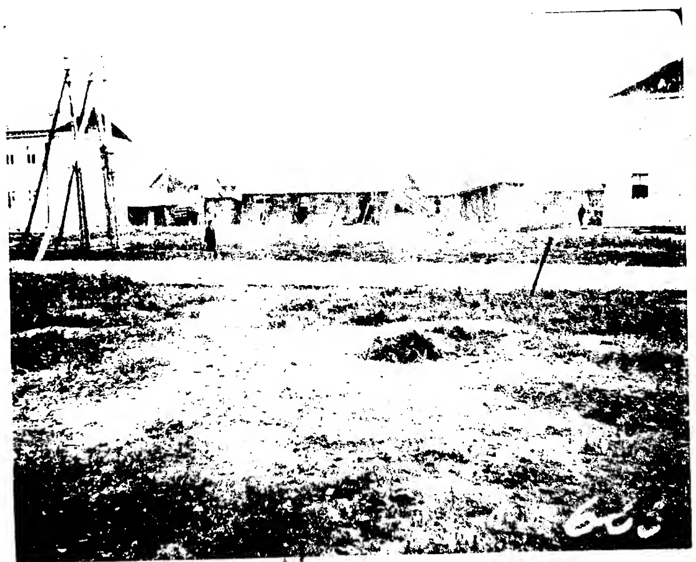
25X1

3

S-E-C-R-E-T

S-E-C-R-E-T

25X1



4

5

S-E-C-R-E-T

INFORMATION REPORT INFORMATION REPORT

CENTRAL INTELLIGENCE AGENCY

C-O-N-F-I-D-E-N-T-I-A-L [redacted] 25X1

PROCESSING COPY

COUNTRY	China	REPORT	[redacted]
SUBJECT	Photographs of Chinese Communist Naval Vessels, Whangpoo River, Shanghai	DATE DISTR.	15 March 1957
		NO. PAGES	2
		REQUIREMENT NO.	[redacted] 25X1
DATE OF INFO.	[redacted]	REFERENCES	25X1
PLACE & DATE ACQ.	[redacted]		25X1

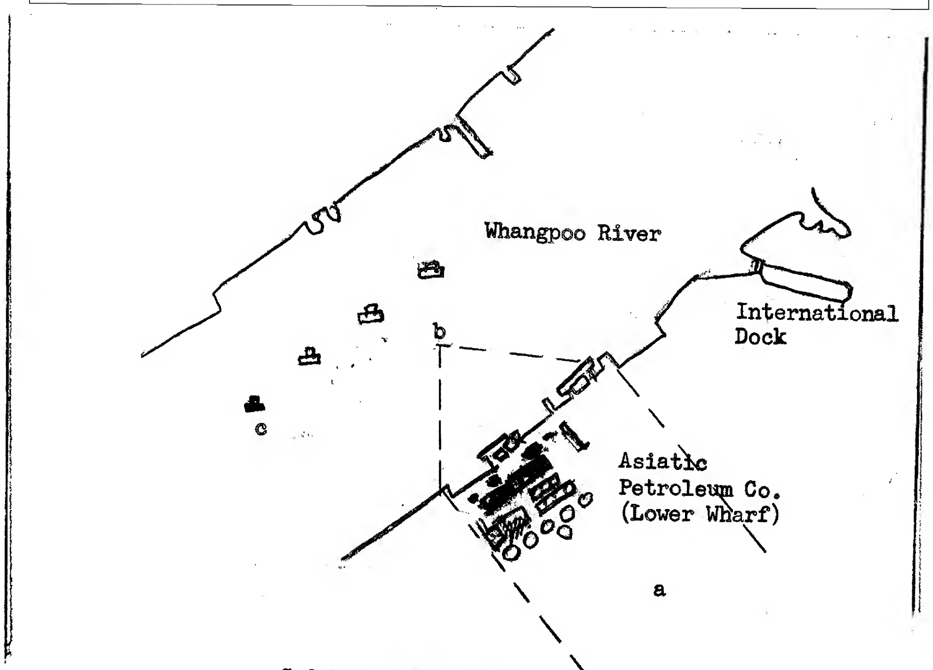
SOURCE EVALUATIONS ARE DEFINITIVE. APPRAISAL OF CONTENT IS TENTATIVE.

[redacted]

1. A series of six consecutive photographs [redacted] of Chinese Communist naval vessels in the Whangpoo River, Shanghai [redacted] 25X1

2. The ships were berthed in the vicinity of the Asiatic Petroleum Company Lower Wharf and photographed from the angle indicated in the following overlay on

CHINA KIANGSU SHANGHAI 31 14 N 121 28 E
SKETCH MAP OF WHANGPOO RIVER PORT AREA. [redacted] 25X1



C-O-N-F-I-D-E-N-T-I-A-L [redacted] 25X1

STATE	X	ARMY	X	NAVY	EV X	AIR	X	FBI		AEC				

(Note: Washington distribution indicated by "X"; Field distribution by "#".)

INFORMATION REPORT INFORMATION REPORT

a. Area photographed.
b. Position of Observer.
c. Buoy No. 20.

3. The vessels photographed include a variety of district patrol craft (YP) motor gunboats (PGM), a possible river gunboat (PR), one LCIL along with other landing ships of the same or of a different type, and other vessels.[1]

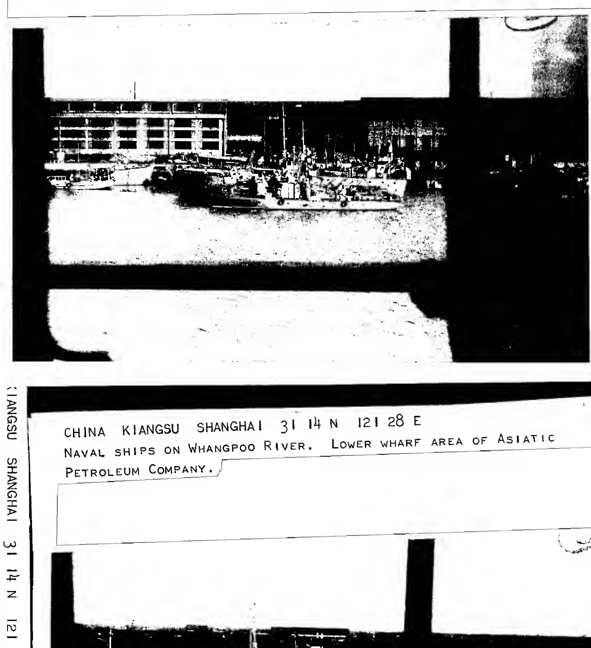
4. In Photograph 6, which shows an LCIL with other landing ships docked inshore of her, the following objects are indicated:

   a. A slipway, covered with nets. No cranes were seen in this area. Chinese naval personnel were observed in the immediate vicinity.

   b. Two, possibly four, tubular objects, which appear to be mounted on chassis, on the foredeck of the LCIL. [redacted] 25X1

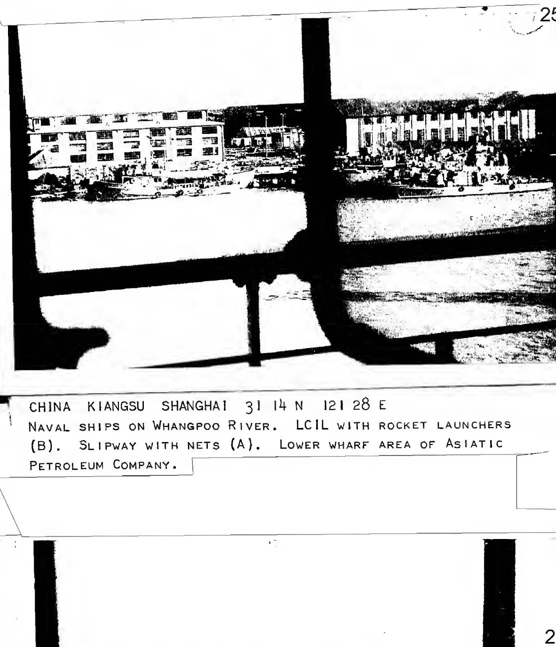
[redacted]

CHINA KIANGSU SHANGHAI 31 14 N 121 28 E
NAVA[L ...]
PETROLEUM COMPANY.



CHINA KIANGSU SHANGHAI 31 14 N 121 28 E
[... WHANG]POO RIVER. LOWER WHARF AREA OF ASIATIC PETRO
PETROLEUM COMPANY.

25X1



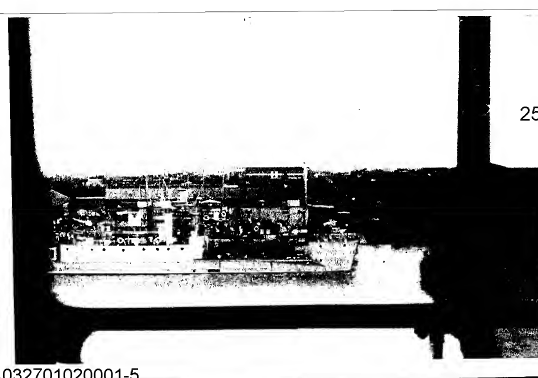
[K]IANGSU SHANGHAI 31 14 N 121 28 E
NAVAL SHIPS ON WHANGPOO RIVER. LOWER WHARF AREA OF ASIATIC

CHINA KIANGSU SHANGHAI 31 14 N 121 28 E
NAVAL SHIPS ON WHANGPOO RIVER. LOWER WHARF AREA OF ASIATIC
PETROLEUM COMPANY.

CHINA KIANGSU SHANGHAI 31 14 N 121 28 E
NAVAL SHIPS ON WHANGPOO RIVER. LCIL WITH ROCKET LAUNCHERS (B). SLIPWAY WITH NETS (A). LOWER WHARF AREA OF ASIATIC
PETROLEUM COMPANY.

25X1

25X1



27N USSR N. EUROPEAN RSFSR MOSCOW OBLAST
NOGINSK 55 50 N 38 28 E
KARLA MARKSA STREET LEADING EAST FROM GUEST HOUSE TO PLANT #12 OF ELEKTROSTAL STEEL PLANT.

[redacted]

25X1

3

27N USSR N. EUROPEAN RSFSR MOSCOW OBLAST
NOGINSK 55 50 N 38 28 E
GUEST HOUSE AT PLANT #12 OF ELEKTROSTAL STEEL PLANT IN WHICH GERMAN SPECIALISTS FROM SINOP WERE HOUSED.

[redacted]

25X1

1

27N US.. N. EUROP.. RSFSR MOSCOW OBLAST
NOGINSK .. 50 N 38 2.
LOOKING WEST-..THWEST FROM GU..T HOUSE OF EL..KTROSTAL STEEL ...T.

[redacted]

25X1

4

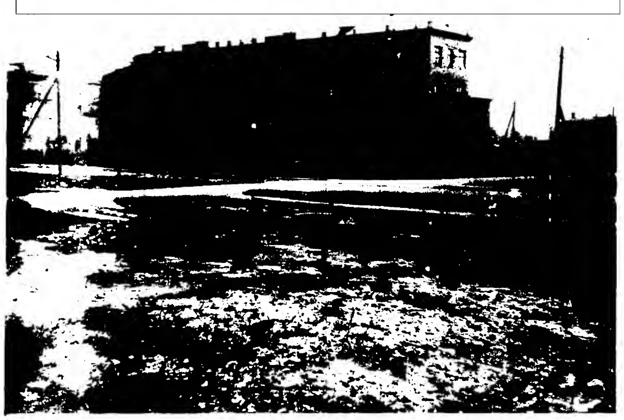
27N USSR N. EUROPEAN RSFSR MOSCOW OBLAST
NOGINSK 55 50 N 38 28 E
LOOKING EAST FROM GUEST HOUSE OF ELEKTROSTAL
STEEL PLANT.

[redacted] 25X1

5

27N N. EUROPEAN RSFSR MOSCOW OBLAST NOGINSK 25X1
55 50 28 E
S AT ELEKTROSTAL STEEL PLANT.

[redacted]



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